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ETHNOBOTANICAL NOTES ON *STEVIA*[1]

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AND A. DOUGLAS KINGHORN[2]

Stevia is an entirely New World genus of herbs and shrubs belonging to the Compositae. Its distribution range extends from the southern United States to northern Argentina, with particular concentration along the Andean mountains. A taxonomic revision of the North American members of the genus was recently completed (Grashoff, 1972), but the South American members remain to be studied systematically. According to Grashoff's revision, 81 species occur in the Americas north of the Colombo-Panamanian border, of which 70 species are found in Mexico alone. Based on the scattered taxonomic treatments of members of this genus in the past, in particular those of Robinson (1930a-c, 1931a-c, 1932a-b), an estimate of 120 species for the South American *Stevia* may be given.

One member of the genus, *Stevia Rebaudiana* (Bertoni) Bertoni, possesses a characteristic sweet taste in its leaves, and apparently has been used as a sweetening agent since antiquity

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by the natives of Paraguay, where the plant is indigenous (Gosling, 1901; Bertoni, 1905, 1918; Sakaguchi and Kan, 1982). Research on the sweetening properties of this species was initiated at the onset of this century, and much is now known about this plant and its constituents. Felippe (1977), Tanaka (1980) and Sakaguchi and Kan (1982) have reviewed the progress and status of research in this area.

Within the past ten years, extracts of *S. Rebaudiana* and stevioside, one of the sweet principles isolated from the plant, have been introduced for use in Japan as sweetening agents and as dietary sucrose substitutes (Sumida, 1973; Abe and Sonobe, 1977; Fujita and Edahiro, 1979; Kazuyama, 1979). The sweetening power of stevioside has been evaluated at 100-300 times that of sucrose, depending on the concentration of sucrose used for comparison (Kamiya et al., 1979).

As a continuation of our current interest in the search of vegetal sweeteners as possible dietary sucrose substitutes (Kinghorn et al., 1982), we have surveyed the literature of *Stevia,* in the hope of finding new leads for the discovery of other sweet-tasting species within the genus. Additionally, field work in Mexico and South America was conducted to inquire of the uses of members of *Stevia.* The results of this field work have been published elsewhere (Soejarto et al., 1983).

As a result of our literature survey, a significant amount of ethnobotanical information concerning members of *Stevia* was uncovered. Contrary to expectation, very little information was found relating to the possible existence of other sweet-tasting *Stevia* species, with the great majority concerned with primarily medicinal uses. These data are presented in this paper to stimulate further research and hopefully will lead to the discovery of additional biologically active compounds from this plant group.

Since there is no current unified classification for *Stevia* throughout its range, the following ethnobotanical data are presented in alphabetical order, according to species. Should the status of a Latin binomial be considered questionable, comments on nomenclature and taxonomy are given.

Certain data have been obtained directly from herbarium specimens of *Stevia* deposited at the John G. Searle Herbarium,

Field Museum of Natural History, Chicago. When this source of data is indicated in the text, the botanical institution is abbreviated as *F*, for the sake of brevity.

NOTES ON *STEVIA* ETHNOBOTANY

Stevia balansae Hieron. in Bot. Jahrb. Syst. 22: 379. 1897.

In the village of Nueva Colombia, near Asunción, Paraguay, the populace drink a decoction prepared from the roots of this species, locally known as *Charúa kaá*, in cases of diarrhea (Soejarto et al., 1983).

Stevia bogotensis Tr. ex Cortés, Flora de Colombia 153. 1919.

According to Cortés (not dated), a plant with this Latin binomial, known locally as *Jarilla* and *Eupatoria*, is used in Colombia as a febrifuge and diaphoretic. This same source indicates that this information applies to other species of the genus in the Bogota area of Colombia. Pérez-Albeláez (1937) added that this plant is used in the Yacopi region of Colombia as a diaphoretic, and is known as *Eupatoria*, *Clavito* and *Eupaloria*.

The Latin binomial *S. bogotensis* is not listed in *Index Kewensis* (1895-1981) and elsewhere, and appers to be an invalid name. Probably, it refers to *Stevia lucida*, which is common in the Bogota area (see below under *S. lucida*), but its correct identity is obscure.

Stevia caracasana DC., Prodr. 5: 121. 1836.

According to von Reis Altschul (1973), a note on the label of an herbarium specimen *(Jahn 1098)* collected in Venezuela in 1922, and identified as *S. elongata* HBK. var. *caracasana* (DC.) B. L. Robins., states that this plant is known as *Molinillo*. Grashoff (1972), however, considered that this taxon is synonymous with *S. caracasana* DC.

Stevia cardiatica Perkins in Bot. Jahrb. Syst. 49: 221. 1913.

This plant has been reported to be used in the treatment of heart diseases (Robinson, 1932b; Cardenas, 1943).

Stevia connata Lag., Gen. Sp. Nov. 27. 1816.

A note on the label of an herbarium specimen *(Steyermark 50493* at *F)* collected in Huehuetenango, Guatemala, in 1942, states that this species is known as *Pericón de monte* and is reputed to be used in treating stomachaches.

Stevia cuzcoensis Hieron. in Bot. Jahrb. Syst. 40: 363. 1908.

This plant is known as *Chipi-cuca* in the Cuzco area of Peru (Herrera, 1930, 1939; Soukup, 1970), but no uses are indicated. However, Herrera *(ibid.)* mentioned that this name also applies to *Polypodium subvestitum* Maxon and *P. Buchtienii* Christ. and Rosenst.

Stevia dictyophylla B. L. Robins. in Proc. Amer. Acad. Sci. 44: 617. 1909.

In Mexico this plant is known as *San Marcos* in the State of Jalisco (Martínez, 1979), but no uses are recorded.

Stevia elatior HBK., Nov. Gen. Sp. Pl. 4: 144. 1820.

According to Lipp (1971), who lived among the Chinantec-speaking people of San Pedro Sochiapam in Oaxaca, Mexico, for a period of six months, the leaves of this plant are used to soothe burns and scratches. The plant is reported to be known as *A-cí.*

Stevia Euptoria (Spreng.) Willd. in Linnaeus, Sp. Pl. 3(3): 1774. 1804.

Known as *Hierba del borrego, Yerba del borrego* and *Cola del borrego,* this species has been reported as being used as a diuretic and antimalarial, and is toxic to livestock (Flores, 1907; Martínez, 1979).

Under the name of *Stevia purpurea* Pers., Roig y Mesa (1953) listed this plant as having been introduced and cultivated in Cuba, where it is known as *Estevia.* Grashoff (1972) considered this Latin binomial to be synonymous with *Stevia Eupatoria* (Spreng.) Willd.

Stevia glandulosa Hook. and Arnott, Bot. Beech. Voy. 296. 1840.

Von Reis Altschul (1973) reported that a note on the label of an herbarium specimen collected in 1927 at San Sebastian in Jalisco, Mexico, states that this species is "used medicinally in fevers". According to Martínez (1979), the common names of this species in Mexico are *Hierba de la pulga* (Oaxaca) and *Merba* (Nayarit).

Stevia hirsuta DC., Prodr. 5: 121. 1836.

A note on the label of an herbarium specimen *(Molina and Molina 26641* at *F)* collected in 1971 at Los Encuentros, Guatemala, states that this species is known as *Oreja de ratón.* No uses are indicated.

Stevia jorullensis HBK., Nov. Gen. Sp. Pl. 4: 112. 1818.

A note on the label of an herbarium specimen *(Molina and Molina 26700* at *F)* collected in 1971 at Chimaltenango, Guatemala, states that this species is known as *Mejorana,* with no other details. In the Federal District of Mexico, the species is known as *Roselina* (Martínez, 1979).

Stevia Lehmannii Hieron. in Bot. Jahrb. Syst. 28: 562. 1901.

A note on the label of an herbarium specimen *(Molina and Molina 26296* at *F)* collected in 1971 at Huehuetenango, Guatemala, states that this species is known as *Oreja de ratón,* with no other details.

Stevia lucida Lag., Gen. Sp. Nov. 28. 1816.

This species is widely distributed from Mexico to Venezuela, with four different varieties recognized by Grashoff (1972): var. *lucida* (Mexico), var. *Robinsoniana* Grashoff (Mexico), var. *hipontini* B. L. Robins. (Mexico) and var. *oaxacana* (DC.) Grashoff (Mexico to Venezuela).

The species is known under many names. In Mexico, it is called *Yerba del aire* (Guanajuato) (von Reis Altschul, 1973) and *Hierba de la araña* (Oaxaca) (Martínez, 1979), in Guatemala *Kebuj* (Totonicapán) (Anonymous 1929a), in Colombia *Chilca* (Pérez Arbeláez, 1936) and *Golondrina sabanera* (Soejarto et al., 1983), and in Venezuela *Chirca* (von Reis Altschul, 1973) or

Chilca (Morton, 1975). Under the name of *Stevia glutinosa* HBK., a synonym of *S. lucida* Lag. (Grashoff, 1972), Pérez Arbeláez (1936, 1937) indicated that the plant is known as *Javillo* or *Jarilla*. Additionally, a note on the label of an herbarium specimen *(Molina and Molina 26709* at *F)* collected in 1971 at Chimaltenango, Guatemala, states that *S. lucida* is known as *Mariposa*.

Several uses have been attributed to this species. Under the name of *S. glutinosa* HBK., Pérez Arbeláez (1936) stated that this species is used externally to soothe pains. According to a note on the label of an herbarium specimen collected in Colombia in 1927, the plant is "used for inflammation" (von Reis Altschul, 1973). A recent field study in the Bogotá area of Colombia (Soejarto et al., 1983) confirmed that a decoction prepared from the aerial parts of this plant is used to soothe inflammation. In Guatemala (Totonicapán) the plant is used to treat rheumatism (Anonymous, 1929a), and according to Morton (1975), who made an evaluation of folk remedies of northern Venezuela, the leafy stems of *S. lucida* are "... sold in bunches in Maracaibo, ... boiled, and the resinous decoction is employed to alleviate rheumatism".

In Mexico, it is interesting to note that the common name *Yerba del aire* may in fact give an indication of the use of this species. According to the Mexican folk medicine, the word *aire* is used to indicate a condition which results when a person comes in contact with *malos aires* (bad air), such as chilly cramps (Díaz, 1976b, p. 316; Latorre and Latorre, 1977). A plant with this name, therefore, may be used to treat such a condition (Martínez, 1969, p. 430).

Stevia Macbridei B. L. Robins. *var.* **anomala.** B. L. Robins. in Contr. Gray Herb. 96: 9. 1931.

Known as *Gualamoco* in the Jauja-Huancayo area of Central Peru, this species has been reported to be used for the preparation of a bath by women (Soejarto et al., 1983). For this purpose, the whole plant is decocted.

Stevia monardifolia HBK., Nov. Gen. Sp. Pl. 4: 115. 1818. (Often misspelled as *monardaefolia;* cf. Grashoff, 1972).

This plant is known as *Mara Antonia* by the people of Zitacuaro, State of Michoacán, Mexico (Soejarto et al., 1983), but no uses are known.

Stevia Nelsonii B. L. Robins. in Contr. Gray Herb. 80: 9. 1928.

In the State of Michoacán, Mexico, this plant is known as *Hierba de la paloma,* but no uses are known (Soejarto et al., 1983).

Stevia nepetifolia HBK., Nov. Gen. Sp. Pl. 4: 146. 1820.

According to Martínez (1979), this species is known as *Zazal* in the State of Sinaloa, Mexico. In Guatemala, according to a note on the label of an herbarium specimen *(Ruano 1268* at *F)* (undated), this plant is known as Anís de ratón.

Von Reis Altschul reported (1973) that a note on the label of an herbarium specimen *(Grant 632)* collected in Guatemala in 1940 and identified as *S. rhombifolia* HBK. states that this plant is known as *Peracón,* and that a tea is prepared in case of dysmenorrhea. Later taxonomic study (Grashoff, 1972) showed that *Grant 632* belongs to *S. nepetifolia* HBK. Grashoff (1972) further indicated that the nomenclaturally correct name for this taxon may be *Stevia suaveolens* Lag.

Stevia origanoides HBK., Nov. Gen. Sp. Pl. 4: 115. 1818.

A note on the label of an herbarium specimen *(Hinton 2277* at *F)* collected in 1932 in the Temascaltepec District of Mexico states that this plant is known as *Amargo,* which means bitter.

Stevia ovata Willd., Enum. Hort. Berol. 855. 1809.

Von Reis Altschul reported (1973) that a note on the label of an herbarium specimen *(Steyermark 51753)* collected in Guatemala and identified as *S. rhombifolia* HBK. states that this plant is known as *Flor de Plata* and *Tuán.* Later taxonomic study (Grashoff, 1972) showed that *Steyermark 51753* belongs to *S. ovata* Willd.

Under the name of *S. rhombifolia* HBK. var. *typica* B. L. Robins., Martínez (1979) reported that this plant is known in Huejutla in the State of Hidalgo, Mexico, as *Cualitaquinina.* According to Grashoff (1972), *S. rhombifolia* HBK. var. *rhom-*

bifolia, that is var. *typica* of B. L. Robins., is synonymous with *S. ovata* Willd.

Stevia petiolata (Cass.) Sch.-Bip. in Linnaea 25: 291. 1853.

In Peru, this species is known as *Guarmi-guarmi* in the Rio Blanco area near Lima, and in the process of baking meat in a covered pit (a practice known as *pachamanca*) it is added to give flavor to the meat (Soejarto et al., 1983).

Stevia pilosa Lag., Gen. Sp. Nov. 26. 1816.

Von Reis Atschul (1973) reported that according to a note on the label of an herbarium specimen collected in Mexico in 1890, this species is known as *Flor de Maria*. Another report (Díaz, 1976b, p. 115) indicated that a plant under the name of *Stevia conferta* DC. is used in Mexico as an antimalarial, antipyretic, cathartic and diuretic. According to Grashoff (1972), this Latin binomial is synonymous with *S. pilosa* Lag.

Stevia polycephala Bertol. var. *polycephala* (Grashoff, 1972).

A note on the label of an herbarium specimen *(Molina and Molina 26362* at *F)* collected at Huehuetenango Guatemala, states that this plant is known as *Mejorana*, without further details.

Stevia puberula Hook., Bot. Miscell. 2: 225. 1831.

According to von Reis Altschul (1973), a note on the label of an herbarium specimen collected in Peru in 1922 states that this species is known as *Lima-lima* and is used as "a tea substitute and stomach medicine".

Stevia punensis B. L. Robins. in Contr. Gray Herb. 100: 8. 1932.

According to Herrera (1939) and Soukup (1970), this species is called *Enduchuīna* in Peru, without further details. It is not clear if this is a Spanish, Portuguese or native name. It may be possible that the name has been derived from the Spanish word "endulzar" (to sweeten).

Stevia Rebaudiana (Bertoni) Bertoni in An. Cie. Parag., ser. I, 5: 1. 1905.

This is the "sweet herb of Paraguay", presently widely used in Japan as a sweetener. According to early reports by Gosling (1901) and Bertoni (1905, 1918) the leaves of this plant have been used by the natives of Paraguay since time immemorial to sweeten foods. One later report (Mazzei-Planas and Kuć, 1968) indicated that, additionally, the milled aerial parts are taken by women in Paraguay as a contraceptive.

The local use of the leaves of this plant as a food additive, for example to sweeten a *maté* beverage, was confirmed during a recent field work in Paraguay (Soejarto et al., 1983), but no confirmation could be obtained concerning the use of the plant as a contraceptive.

More recent reports (Angelucci, 1981; Soejarto et al., 1983) indicated that *S. Rebaudiana* is also used in Paraguay as a tea for the treatment of diabetes. Such use, however, appears to be of modern origin, due to reports on the hypoglycemic activity of extracts of the leaves of this plant (Soejarto et al., 1983). Angelucci (1981) further added that the plant is used to regulate arterial pressure in hypertensive persons.

Sakaguchi and Kan (1982) mentioned that historical evidence on the use of *S. Rebaudiana* as a sweetener in South America is found in the documents of the Spanish conquerors preserved in the National Archives in Asunción, Paraguay.

In Paraguay, *S. Rebaudiana* is known in the Guarani language as *Caá-êhê* (Gosling, 1901), and *Caá-êhé* and *Kaá-Hêé* (Bertoni, 1905, 1918), *Caá-ehe* and *Azucá-caá* (Cabrera, 1939), *Caá-hê-hê* or *Caá-enhem* (Mors and Rizzini, 1966), and *Ka-á Hê-e* (Soejarto et al., 1983) or by other renditions, all of which mean sweet herb. Pío-Corréa (1926) applied the name *Caá-ehé* erroneously to *Stevia collina* Gardner, believing that this is the sweet-tasting species. At the same time, *S. Rebaudiana* was confused with being a Brazilian plant growing in the areas of Minas Geráes, São Paulo and Matto Grosso, although in fact, the native territory of this species is the Cordillera of Amambay, Paraguay (Gosling, 1901; Bertoni, 1905, 1918; Sumida, 1973; Soejarto et al., 1983).

From a nomenclatural standpoint, the correct name of this taxon is *Stevia Rebaudiana* (Bertoni) Bertoni (1905), not *S. Rebaudiana* (Bertoni) Hemsley (1906), for reasons of priority.

Stevia rhombifolia HBK., Nov. Gen. Sp. Pl. 4: 112. 1818.

According to Grashoff (1972), the Latin binomial *Stevia rhombifolia* as applied to the North American specimens is very ambiguous and confusing, and refers to three distinct taxa: *S. jorullensis* HBK., *S. ovata* Willd. and *S. triflora* DC. However, its correct identity concerning the South American specimens is yet to be elucidated. In the present paper, ethnobotanical information associated with this Latin binomial is found under *S. ovata, S. nepetifolia* and under *Stevia* species *(Molinillo* and *Salvia).*

Stevia salicifolia Cav., Icon. Descr. Pl. 4: 32. 1797.

This species, whose distribution range extends from Mexico to southern United States (New Mexico), is known under various common names. The names used in Mexico are *Hierba del aire* (Hidalgo), *Hierba de la mula* (Guanajuato), *Zazal* (Sinaloa) and *Zazale de olor* (Martínez, 1979), and *Yerba de la mula* (von Reis Altschul, 1973). In addition, in the States of Michoacán and Mexico, it is known as *La envidia, Yerba de la mula* and *Zazal.* Small bundles of the dried aerial parts of *S. salicifolia* are offered for sale in the Juárez market of Toluca under the name of *Zazal,* where vendors advise that a water decoction or an alcoholic infusion may be used as a rub for rheumatism (Soejarto et al., 1983), whereas in the region of Morelia (Michoacán) the plant is used for the same purpose, but under the name of *Yerba de la mula.*

Under the name of *Stevia stenophylla* A. Gray, Martínez (1979) reported that this plant is called *Hierba de la Santa Rita* in the State of San Luis Potosi, Mexico. Grashoff (1972) considered this Latin binomial to be synonymous with *S. salicifolia* Cav.

Stevia satureifolia Sch.-Bip. in Linnaea 25: 291. 1853.

A number of species of the Compositae *(Eupatorium, Mikania* and *Stevia)* are referred to as *Guaco* by Pío-Corréa (1952),

and stated to be "meliferas" or honey-bearing, including *S. satureifolia* Sch.-Bip. from the Río Grande do sul, Brazil. Additionally, the common names *Charrúa, Tomillo silvestre* and *Yerba del Charrúa* used in Uruguay are attributed to this species. However, since Pío-Corréa followed the wide concept of *S. satureifolia* as proposed by Baker (1876), who recognized five different varieties as the result of reduction of the same number of species, a concept which needs further re-examination (cf. Robinson, 1931a), it is not clear to which subspecific division each of the Uruguayan common names refers to.

Stevia serrata Cav., Icon. Descr. Pl. 4: 33. 1797.

A note on the label of an herbarium specimen *(Cominsky 74* at *F)* collected in Guatemala in 1974, as part of a project on medicinal plants, states that this plant is known as *Q'ang'aj* and used as a cough remedy. Another herbarium specimen *(Molina and Molina 26288* at *F)* bears a field label with a note, stating that the plant, collected in Huehuetenango, Guatemala, in 1971, is known as *Anís silvestre.* One report (Anonymous, 1929b) states that this species is also known in Guatemala as *Hipericón arrie.*

Without citing any reference, Díaz (1976a) stated that, in Mexico, the names *Tlalacxoyatl* and *Tlalchichinole* refer to *Stevia linoides,* a synonym of *S. serrata* Cav. (Grashoff, 1972).

Stevia subpubescens Lag. *var.* **intermedia** Grashoff in Brittonia 24: 392. 1972.

Soejarto et al. (1983) reported that in the Zitacuaro region in the State of Michoacán, Mexico, this plant is known as *Zazal,* and that the decoction of the aerial parts is used as a bath by women after parturition, whereas the leaves are used for stomachache. In the same report, it is mentioned that the medicinal herb vendors in the market of Patzcuaro (Michoacán), who call the plant *Hierba de la mula,* recommend its use to treat pains in the joints, by rubbing in the *fried* plant.

Stevia trifida Lag., Gen. Sp. Nov. 27. 1816.

According to a note on the label of an herbarium specimen collected in Mexico in 1898, this plant is known as *Manzanilla*

de agua, and an infusion of the roots and flowers is used to treat dysentery (von Reis Altschul, 1973).

Stevia viscida HBK., Nov. Gen. Sp. Pl. 4: 110, pl. 351. 1818.

In Mexico, this plant is known as *Matapulgas* and *Pipizhuatl* in the State of Jalisco, and as *Hierba de la pulga* in the State of Mexico (Martínez, 1979). The use of the name *Pipitzáhuatl* (Hernández, 1946; Martínez, 1979) for this species appears to have its origin in the work of Sessé and Moçiño, who described *Ageratum purpureum* Sessé and Moçiño (1893) and referred it to *Pipitzáhuatl. Ageratum purpureum* Sessé and Moçiño is a synonym of *Stevia viscida* HBK. (Grashoff, 1972).

In Guatemala, this plant is known as *Mejorana,* according to a note on an herbarium specimen *(Molina and Molina 26559* at *F)* collected in Huehuetenango.

STEVIA SPECIES

Uses of several *Stevia* species are reported in the literature, but the specific identities of the plants are presently either unknown or questionable. Among such reports are those found in the book *Natural History of Plants of the New Spain* written by Francisco Hernández, a Spanish physician, between 1570 and 1576. This book has been published several times in Latin and Spanish, between 1605 and 1959 (Hernández, 1959). In this book, plants listed under their Nahuatl names are given brief descriptions concerning botanical characteristics and medicinal virtues, and sometimes provided with illustrations. The rich information contained in this book has prompted Schultes (1962) to call it an "incredible treasury". It is also considered as a very reliable source of information by del Pozo (1969). A relatively recent edition of the book was published in Spanish, in 3 volumes (Hernández 1942: vol. 1, 1943: vol. 2, 1946: vol. 3). In this edition, the editors have provided a tentative identification or, more correctly, interpretation, to a great number of the plants. Thus, the equivalent Latin binomials are provided. In spite of these Latin binomials and the remarkable accuracy of interpretation, the final and correct botanical identity of many

of the plants, including species of *Stevia,* remains the subject of conjecture.

Stevia or possible *Stevia* species mentioned in Hernández's book and others reported elsewhere are listed below, according to their vernacular names, in alphabetical order.

1. Albahaca del campo

A species of *Stevia* collected in Argentina in 1936 and referred to as *Albahaca del campo* is listed in von Reis Altschul's book (1973), without further details.

2. Anonima mechoacanense

In Hernández's book (1943, p. 481), a plant referred to as third *Anonima mechoacanense* is listed, and has been interpreted as a *Stevia* sp. From the illustration provided, it can be said that it is not a species of *Stevia,* since the illustrated plant has verticillate (in 5's) leaves, which does not occur in *Stevia.* Interestingly, Hernández's text stated that his notes concerning the uses of plant were lost, hence the use of the word *Anonima,* which means anonymous.

3. Camopaltic

Several plants in Hernández's book are called the first, second and third *Camopaltic,* a Nahuatl word which means herb with purple color. The identity of the third *Camopaltic* is given as *Stevia clinopodia* DC. (Hernández, 1946, p. 844). According to Grashoff (1972), the legitimate name for *S. clinopodia* DC. is *S. jorullensis* HBK. An illustration of the plant is here reproduced (Fig. 1).

Concerning uses, Hernández noted that the plant is a "cold herb", and that "half an ounce of the roots taken with water evacuates the urine".

In an earlier work by Urbina (1906), the third *Camopaltic* was given a different interpretation as either *Stevia linoides, S. laxiflora, S. purpurea* or *S. paniculata,* but it was noted that the most likely was *S. linoides,* due to the similar form of the leaves to flax. These Latin binomials are all illegitimate names and, according to Grashoff (1972), their legitimate names are *Stevia*

Fig. 1. A photograph of the third *Camopaltic* from Hernandez's book, Natural History of the Plants of the New Spain, Spanish edition (Mexico), vol. 3, p. 844, 1946. See text for further details.

serrata Cav. (for *S. linoides* Sch.-Bip.), *S. viscida* HBK. (for *S. laxiflora* DC). and *S. ovata* Willd. (for *S. paniculata* Lag.). As to *S. purpurea,* Grashoff stated that this is an ambiguous name, which includes elements belonging to *S. viscida* HBK., *S. pilosa* Lag., *S. Eupatoria* (Spreng.) Willd. and *S. porphyrea* McVaugh.

Since species of *Stevia* are delimited not only on the basis of vegetative and inflorescence characters, but also on the basis of minute floral and achene characters, which cannot be verified

from the illustration, the correct species identity of the third *Camopaltic* remains unanswered.

4. Cihuapatli pitzahoac

A plant with this name is listed in Hernández's book (1946, p. 894) and has been interpreted as *Stevia viscida* HBK. It is stated that it has ". . . a slightly bitter taste. The leaves applied prevent the fall of hair".

The interpretation of this plant as *S. viscida* appears to have been due to the fact that in some parts of Mexico, the common name for this species is *Pipitzáhuatl* (see note under *S. viscida,* above). However, very similar names are used for *Perezia* and *Eupatorium* species (Martínez, 1969).

5. Cihuapatli yacapichtlense

A plant under this name is listed in Hernández's book (1946, p. 888) and has been interpreted as either *Baccaharis glutinosa* Pers., *Stevia viscida* HBK. or *S. salicifolia* Cav. An illustration provided (1946, p. 889, fig. 215) depicts a plant with alternate leaves, which corresponds to either a *Baccharis* species or *S. viscida,* but not to *S. salicifolia,* which has opposite leaves. According to the description, the plant has purple flowers, common in *Stevia,* whereas *Baccharis* has a yellowish flower color.

The word *Cihuapatli* means, in the Nahuatl language, medicine for women, whereas the epithet *yacapichtlense* refers to the locality of the plant in the State of Morelos, presumably used in order to distinguish it from the 22 other Cihuapatlis mentioned in the text.

The properties of *Cihuapatli yacapichtlense* are stated thus: "Its decoction drunk or applied resolves admirably the humours which have penetrated the joints and nerves, and calms any pains by eliminating their cause" (Hernández, 1946, p. 888). In the same text, the plant is also referred to as *Pitzahoaccihuapatli.*

6. Kaadyupé

This name was used by Bertoni (1914) to refer to a species of *Stevia* from Paraguay, but without further details.

7. Molinillo

Pittier (1926, p. 300) mentioned that *Stevia urticifolia* Thunb. is known in Venezuela as *Molinillo*. However, a case of misidentification appears to be involved, which is evident from the following statement by Robinson (1931b):

> "*S. urticifolia* Thunb., as employed by Knuth, covers material collected by Pittier and by Jahn, which was in part *S. Wageneri*, in part *S. rhombifolia* var. *stephanocoma* Sch.-Bip and as to the rest *S. elatior* HBK., while the real *S. urticaefolia* Billb. ex Thunb. is a Brazilian plant as yet unknown from Venezuela".

It is interesting to note that von Reis Altschul (1973) enumerated *Molinillo* under *Stevia elongata* HBK. var. *caracasana* (DC.) B. L. Robins., based on information from a specimen *(Jahn 1098)* collected from Venezuela. (See note under *S. caracasana*, above). This same specimen has been identified by Robinson (1931b) as *S. elongata* var. *caracasana*, but without associating it with the common name *Molinillo*.

One suspects that Pittier may have referred to one and the same specimen, i.e. *Jahn 1098*.

8. Pericón Blanco

Martínez (1969) considered that a plant known under this name in the Tasco region of Mexico is a species of *Stevia*, and that "... dried leaves and flowers, boiled in water with salt, are used against colic".

9. Salvia

According to one report (Anonymous, 1929b), *S. rhombifolia* HBK. is known in Guatemala as *Salvia*.

Grashoff (1972), however, considered that the Latin binomial *S. rhombifolia* is very ambiguous and has been confused by different authors, and actually refers to three distinct species: *S. ovata* Willd., *S. triflora* DC. and *S. jorullensis* HBK. Based on this concept, the identity of *Salvia* is not known with certainty.

10. Tlacochichic de ocopetlayuca

A plant under this name is listed in Hernández's book (1943,

p. 583) and has been interpreted as a species of *Stevia*. *Tlacochichic* means, in the Nahuatl language, bitter stem.

The uses of the plant are stated as follows: ". . . the juice of ar ounce of the root drunk with water evacuates the phlegmatic humors through the inferior conduit. It is hot and tastes acrid and bitter. The people from the Panuco region (Veracruz, Mexico) say that it cures scabies and abdominal pains, and reduces the spleen".

11. Tlalchichinole

According to Martínez (1969) a plant known as *Tlalchichinole* in the Guerrero State, Mexico, belongs to *Stevia,* and a decoction is used to wash infected pimples. See also note under *Stevia serrata*.

12. Tonalxihuitl

Twelve plants under this name are listed in Hernández's book (1942) and one of these, which is referred to as first *Tonalxihuitl* (Hernández, 1942, p. 56) has been interpreted as *Stevia salicifolia* Cav. The description corresponds to the characteristics of this species, but no illustration is provided, for purposes of comparison. The text states that the roots of the plant are ". . . excellent in reducing fevers, when crushed and rubbed or drunk in a dose of an ounce".

Another plant called *Tonalxihuitl yacapichtlense* has been interpreted as *Veronica americana* Schwein. ex Benth. (Hernández, 1942, p. 57).

In the Nahuatl version of the 16th century Florentine Codex written under the direction of Bernardino Sahagún, using direct information from Aztec physicians, there are three mentions of *Tonalxihuitl* plants, which, in the English translation of this codex (Sahagún, 1961, 1963), are interpreted, following Hernández's book, as *Stevia salicifolia* or *Veronica americana*. According to the illustration provided (Sahagún, 1963, fig. 574). the plant has alternate leaves, which do not correspond to the characteristic of *S. salicifolia*. Under the section of the book which ". . . telleth of the ailments of the body and of the medicine . . .", *Tonalxihuitl* is stated to be used as follows:

> "If the chest, the back, the ribs, the rib cage hurt, if she aches in all parts of her body, she is anointed with a collection of diverse herbs: *Tlaquequetzal, Tonalxihuitl, Alzitzicaztli, Atzomiatl.* They are ground; they are mixed with lampblack and *Axin* in order to be applied as an ointment. But first she is to bathe in hot wormwood (water)." (Sahagún, p. 1961, p. 152).

In another section which "... telleth of the medicinal herbs ...", *Tonalxihuitl* is stated to be used as follows:

> "[The foliage] is ground up. It is required by one who has pimples. Moistened, it is placed there where the pimples are.
>
> And its root is useless, of no value. And this one, when someone tastes it, deadens the tongue somewhat". (Sahagún, 1963, p. 167).

DISCUSSION

On the basis of the data presented above, the following observations can be made.

1. The application of the same common name(s) to more than one species.

Several cases may be cited, in which the common names have been applied to more than one *Stevia* species. The reasons for this are not always clear, but in some cases an explanation may be in order.

For example, the common names *Hierba de la mula* and *Zazal* are used in the central part of Mexico for *S. salicifolia* and *S. subpubescens.* The basis for this appears to be morphological similarity. Both species are shrubs with linear to lan-ceolate leaves, and with dense corymbs of white capitula. Additionally, the distribution of the two species overlaps in this geographic region. Another similar example is the use of the name *Hierba del aire* for both *S. lucida* and *S. salicifolia,* morphologically similar species.

On the other hand, the name *Hierba de la pulga* has been applied to *S. glandulosa* and *S. viscida,* two morphologically distinct species (see also Grashoff, 1972). Apparently, in this case, the basis is similarity of uses of the plants, namely as insect repellents. *Hierba de la pulga* means the flea's herb. The application of the name of *Hierba de aire* for both *S. lucida* and *S. salicifolia* may also be explained on the basis of similarity in use.

As for the application in Guatemala of the common name *Mejorana* for *S. jorullensis, S. polycephala* and *S. viscida,* the reason is not clear, since these three species are not related taxonomically, or are morphologically similar (Grashoff, 1972). It may be noted, however, that the word *Mejorana* in Spanish is often used to refer to aromatic herbs, such as *Origanum Majorana* L. (sweet marjoram).

To cite another example, the common name *Oreja de ratón* (mouse's ear) has also been applied to *S. hirsuta* and *S. lehmannii,* two taxonomically unrelated species.

2. Pharmacological studies

Of all the species enumerated in this paper, only *Stevia Rebaudiana* has been investigated most thoroughly, in terms of its botany, phytochemistry and pharmacology (Felippe, 1977; Angelucci, 1981; Sakaguchi and Kan, 1982). Obviously, this has been due to the sweet properties of this plant, and to its potential as a sweetener.

Aside from *S. Rebaudiana,* only in one other species, namely *S. Eupatoria,* have observations on the pharmacological effects of its crude extracts been made. Thus, a series of reports (Armendaris, 1905; Loaeza, 1905; Lozano y Castro, 1905; Martínez del Campo, 1905; Ruíz, 1905; Villaseñor, 1905; Flores, 1907) were published at the beginning of this century, detailing the results of experiments in rabbits, sheep and pigeons, as well as clinical observations in humans, using water infusions of *Stevia Eupatoria.* These experiments were performed at the Instituto Medico Nacional in Mexico, in an attempt to verify the diuretic, antimalarial and toxic effects claimed for the plant.

The results of these studies were summarized as follows (Flores, 1907):

i. Dried plants, when ingested by rabbits and sheep, did not produce any toxicity.
ii. In the pigeon, a water infusion produced a purgative effect, even when administered intravenously.
iii. In rabbits, no increase of urinary secretion was produced after administration.
iv. Clinical observations of the root decoction as a diuretic showed that it worked in the majority of cases, but a defini-

tive pharmacological action leading to the stimulation of diuresis was not demonstrated.

v. As an antimalarial, various preparations (decoction, tincture, and fluid extract) of the roots administered orally showed negative results, except in one case.

vi. Toxic effects in humans included nausea, vomiting and diarrhea, at a daily dose of 200 g of a 10% decoction, in more sensitive individuals.

3. Phytochemical basis of ethnomedical uses

The diverse folk medicinal uses of *Stevia* species perhaps stem from the bitter taste of its members (Soejarto et al., 1983), a property often associated with medicinal virtues. This bitter taste is probably due to the presence of sesquiterpene lactones (Rodriguez et al., 1976; Rodriguez, 1977) or to certain diterpenes (Cocker, 1966; Sticher, 1977). Sesquiterpenes appear to be characteristic in plants of the Compositae (Hegnauer, 1977; Herz, 1977), and have been isolated previously from several species of *Stevia* (Ríos et al., 1967; Salmón et al., 1973; Rodríguez et al., 1976; Salmón et al, 1977; Bohlmann et al., 1979, 1982). The extent to which these principles are responsible for alleged therapeutic activities in members of *Stevia* remains to be investigated.

Many species of *Stevia* exhibit a pungent to pleasantly aromatic odor, which in certain species has been referred to by Grashoff (1972) as a goat's smell. Strong and aromatic odors from plants are due to the presence of essential oils, which possess rubefacient, irritant and antimicrobial properties (Harvey, 1975). Montés (1969) and Fujita et al. (1977) have demonstrated the presence of volatile constituents in *Stevia satureifolia* and *S. Rebaudiana*, respectively. This attribute may be responsible for certain alleged therapeutic uses, such as antipyretics, antirheumatics, diaphoretics, and to treat burns, scratches, and skin diseases.

For other therapeutic activities, for which species of *Stevia* have been allegedly used, as antidiarrheals, uterine relaxants (antidysmenorrheics), in the prevention of hair from falling, and in cardiac treatments, to mention only a few, the phytochemical basis is not known at present.

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BOTANICAL MUSEUM LEAFLETS
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PAREIRA BRAVA: 19TH CENTURY NOTES AND COMMERCIAL SAMPLES FROM E. R. SQUIBB, M.D.

PHILLIP M. RURY*

RADIX PAREIRAE BRAVAE *("root of pareira brava")* was first introduced to Europe by the Portuguese, on the basis of its indigenous use in Brazil as a virtual panacea—with diuretic, lithontriptic, vulnerary, stomachic, cordial and alexipharmic properties (Pomet, 1692; Squibb, 1872 and Hanbury, 1873). According to Hanbury (loc. cit.) the first published account and illustration of *radix pareirae bravae* appeared in 1692, in Pomet's *Histoire des Drogues*. Apparently, Pomet's description and illustration provided the typology for *pareira brava*, upon which the authentication of commercial samples depended during the next two centuries.

In 1872, Edward R. Squibb, M.D., praised the utility of *pareira brava* in the treatment of "chronic diseases of the mucous membranes of the urinary passages", referring to it as "a drug which has withstood the mutations of therapeutics and commerce for nearly two hundred years." Squibb cautiously avoided the taxonomic debate over the botanical origin of the drug, and wisely warned his medical and pharmaceutical colleagues that "Under a name so indefinite as 'wild vine' or 'bastard vine'—the translation of the name *Pareira Brava*,—it is hardly possible that the markets should have always been supplied from the same plant, even after its botanical source was determined, and hence the varying descriptions of different authorities may be accounted for."

Dr. Squibb also noted that in order to be efficacious, the *pareira brava* of the New York market required administration in "doses very much larger than those prescribed by the books."

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Apparently, this aroused suspicion in Squibb's mind as to the authenticity and quality of botanical importations under the name *pareira brava,* and he began to scrutinize commercial samples more carefully. Subsequently, he noticed a very heterogeneous parcel of Brazilian *pareira brava,* recently imported from Europe, and was "surprised to find nearly one-half of it so entirely different from any hitherto seen", initially declaring it a "fraudulent adulteration or substitution". Squibb soon discovered that this new importation was actually "a mixture of stem and root", and that the "taste of the root is very much stronger, and yields at least twice as much extractive material to the menstrua." Upon closer examination, he also found that this shipment agreed quite well with many of the older published accounts of *pareira,* especially with the illustration of Pomet (loc. cit.) and conceded that "this was the true *pareira* root", and what he "had heretofore seen was the stem." Squibb thereupon concluded that "for some twelve or fifteen years past, this market has been supplied with the comparatively inert stem, instead of the root of *pareira*."

In 1873, Daniel Hanbury commented on the "extremely obscure" botanical origin of the "various stems and roots known as *Pareira Brava",* noting that most writers have referred to the drug, without question, as *Cissampelos Pareira* L., of the family Menispermaceae. Hanbury was the first to obtain and study comparatively both stems, roots *and* herbarium specimens from the same plant of *Cissampelos Pareira,* from several sources throughout the species' pantropic range: Brazil, Ceylon, Jamaica and Trinidad. Hanbury compared these authenticated specimens with the published accounts and illustration of *pareira brava,* and declared that this drug was *not* derived from *Cissampelos Pareira:* "neither the stem nor the root of the plant resembles any of the forms of that drug I had ever met with in commerce". Hanbury also gave a short history of *pareira brava,* emphasizing that *Cissampelos Pareira* in no way resembles a "wild vine" reminiscent of the grape vine, for which the Portuguese colonists in Brazil had named it *"pareira brava".* Hanbury noted further that specimens of *Chondodendron tomentosum* Ruiz & Pavón, sent to him from Brazil by Mr. Theodore Peck-

olt, conformed to the descriptions and illustrations of *pareira brava* in the literature. Upon concluding that the true *pareira brava* was derived from plants of *Chondodendron tomentosum*, Hanbury (loc. cit.) mentioned the report of Peckolt that two forms (ecotypes?) of *pareira* exist in Brazil: (1) "*Pareira brava legitima*" (*N.v.* "Butua"), a larger plant from drier areas and (2) "*Pareira brava miuda*" (*N.v.* "Butinha"), a plant of much smaller stature, and common in wetter habitats than the former. Hanbury also included a list of what he considered to be nomenclatural synonyms for *Chondodendron tomentosum*, evidently the first account of synonymy for this plant. Of special interest is Hanbury's description of a *third* sort of *pareira brava* from Guiana and northern Brazil, known there as "*Pareira brava grande*", and purportedly derived from another species of Menispermaceae—the liana *Abuta rufescens* Aublet,—which he had never before seen in commerce. Hanbury also was convinced that the shipment of *pareira brava* described by Squibb (1872), as a mixture of stem and root of the same plant, must also have been *Chondodendron tomentosum*, rather than *Cissampelos Pareira*.

Hanbury's generic determination of *pareira brava* as *Chondodendron* was later supported by Krukoff and Moldenke (1938), although these authors identified *both* of the specimens ("forms") sent by Peckolt to Hanbury, as *Ch. platyphyllum* (A. St. Hil.) Miers rather than *Ch. tomentosum*, on the basis of floral morphology. Krukoff and Moldenke also suspected that *Ch. microphyllum* (Eichl.) Moldenke, a close, south Brazilian relative of *Ch. platyphyllum*, may also represent a source of commercial *pareira brava;* this was later confirmed by Krukoff and Barneby (1970).

Squibb (1872) had commented that importations under the name of *pareira brava* probably were of heterogeneous botanical origin, a belief more recently reiterated by both Thomas (1963) and Morton (1977). The phytochemical heterogeneity of *radix pareira bravae* was suspected by Squibb (loc. cit.), who noted a difference in both taste and dosage requirements between root and stem, and confirmed by King (1940, 1946), who first isolated the alkaloid bebeerine from *Radix pareirae bravae*. King dem-

onstrated that *Radix pareirae* prepared from *Chondodendron microphyllum* yields *d-bebeerine*, whereas that obtained from *Ch. platyphyllum* yields *l-bebeerine!* The pharmacologic and commercial significance of these phytochemical data are self-evident, and they served to underscore the suspected plant taxonomic heterogeneity, of imports under the general name of *pareira brava*. More recently, Krukoff and Barneby (1970) noted the different pharmaceutical uses of *Chondodendron* species: *Ch. tomentosum* as the preferred source of d-tubocurarine, whereas both *Ch. microphyllum* and *Ch. platyphyllum* provide the "source of the drug known in pharmacy as *'radix pareirae bravae'*."

Two hundred years of nomenclatural and taxonomic confusion over the botanical identity of *pareira brava* is hardly surprising from an ethnobotanical perspective. Among indigenous peoples of the Amazon basin, various mixtures of taxonomically diverse, tropical lianas and other plants are used in the preparation of arrow and dart poisons, collectively referred to as "curare". In most cases, species of either the genus *Strychnos* (Loganiaceae) or *Chondodendron* (Menispermaceae) are added as the major, active principle of curare (Krukoff & Smith, 1937). At least five species of *Chondodendron* have been used in curare preparation by various Amazonian tribes (Krukoff and Moldenke, 1938). Furthermore, other genera of Menispermaceae are used in curare recipes, by various tribes and/or in different regions of the Amazon, including *Abuta, Anomospermum, Cissampelos* and *Sciadotenia* (Krukoff and Smith, 1937, 1939). These authors also noted that the Canelos of the Río Conambu basin in Ecuador sometimes substitute *Cissampelos Pareira* for *Chondodendron tomentosum* in their curare preparations, but refer to both taxa by the same common name. Similarly, Morton (1977) notes that in commerce, the "root" of the pantropic *Cissampelos Pareira ("false pareira")* often is substituted for *"true pareira root"*. She considers the true drug to be *Chondodendron tomentosum*, in accord with Hanbury (1873) but contrary to the conclusion of Krukoff and Moldenke (1938), who believe *pareira brava* to be derived from *Ch. microphyllum* and *Ch. platyphyllum*. It would appear that, at least in the minds of the Amazonian natives, *"pareira brava"* was a very general term,

imprecisely applied to diverse genera and species of Menispermaceae, which often are employed in curare preparation and collected for export to the pharmaceutical industry.

RADIX PAREIRAE BRAVAE: *Root or Rhizome?*

Historically, the *"radix"* of *"pareira brava"* has been interpreted as the "root" of the plant (literal translation), an apparent plant morphological misnomer for the part actually used, which hitherto has not been challenged in the botanical or pharmaceutical literature. Although no distinction among root, rhizome and aerial stem of *pareira brava* has appeared, all published descriptions of the so-called, "root of *pareira*" clearly are more characteristic of *Chondodendron* rhizomes, than of its roots and aerial stems.

Pomet's original description and illustration of *"pareira brava" root* (1692) clearly suggests a rhizome rather than a true root, as is evident in the 1712 translation of his account: "that the said Root, as it grows in the Ground, shoots forth Branches charg'd with Leaves, altogether like the Vine which creeps along Walls and upon Trees." Squibb (1877) also referred to "the part which I perhaps mistakenly considered to be the root, but is without much doubt the substance described by the older writers", perhaps thinking that this might not be a true root in the botanical sense. Hanbury (1873) described "roots bearing some leaves", and notes that "In Mr. Francis' drug there are young roots having the remnants of green aerial stems arising from their upper part...". By definition, of course, roots *never* bear leaves.

Even more recently, this apparent misapplication of the term "root" to *pareira brava* rhizomes has been perpetuated. Morton (1977) thoughtfully presented a whole-plant morphological diagnosis for *Chondodendron tomentosum*, which she considers to be the *true pareira brava*, but referred to the plant part used medicinally as the "root", rather than rhizome. However, the morphological description which she gives for the rhizome of *Chondodendron tomentosum* is virtually identical to all historical descriptions of the so-called *"pareira root"*, as contrasted with its very different, woody stem.

Diagnostic features which have repeatedly been published for "*pareira root*" include: (1) a very dark, almost black color; (2) transverse constrictions or furrows; (3) longitudinal wrinkles, and often, (4) green leafy shoots arising from the upper sides of the "root". Together with the descriptions, published illustrations of "*pareira root*" clearly suggest the morphology of a subterranean rhizome; probably with jointed nodes ("transverse constrictions"), scale-leaves with axillary buds giving rise to leafy aerial shoots, and perhaps an occasional foliage leaf borne upon light-exposed nodes of the rhizome.

Although this may seem a minor semantic distinction relevant only in comparative plant morphology, its potential commercial and practical significance in medicine cannot be overemphasized. The necessity of such accurate morphological distinctions was fully appreciated by Dr. Squibb (1872, 1877), who noted differences in both potency and efficacy, of "*pareira* roots" as compared with its "woody stems". It is widely recognized among botanists and chemists, furthermore, that different organs of an individual plant often reveal both qualitative and quantitative chemical differences and different pharmacological effects (*e.g.*, Manske and Holmes, 1950). As noted by Thomas (1963), the comparative phytochemistry of *pareira brava*, curare plants and other Menispermaceae is incompletely understood. Ideally, future phytochemical investigations of this family (and plants in general) should carefully distinguish among the (1) plant organs being analyzed, (2) their relative maturity and vigor, and (3) the precise ecological conditions experienced by the individual.

A LETTER AND PAREIRA BRAVA SPECIMENS FROM E. R. SQUIBB

Dr. Squibb was fully aware of the probable, botanical heterogeneity of commercial *pareira brava*, as indicated by the foregoing excerpts from his 1872 publication. In 1877, he sent a letter of enquiry (Plate 1; Transcription #1), four commercial samples of *pareira brava* (Plates 3-6), and a certificate of authenticity from the importers pertaining to one of these *pareira* shipments (Plate 2; Transcription #2) to Professors

George Goodale and Asa Gray of Harvard University, *via* his son (E. H. Squibb) who resided in Cambridge, Massachusetts. Dr. Squibb had collected these *pareira* samples in the New York market since 1865, apparently since he suspected them to be of diverse botanical origin, and sent them to Harvard for professional identification on the basis of "Structural Botany". These samples were either ignored or misplaced for over 100 years, before I found them as indetermined and unaccessioned samples in the Harvard Wood Collection.

Dr. Ralph H. Wetmore, co-founder of the Harvard Wood Collection and the Bailey-Wetmore Laboratory of Plant Anatomy and Morphology, wherein the wood collection resides, noted that he had never before seen these *pareira* samples nor the accompanying letter from E. R. Squibb (pers. comm., 1982). Dr. Wetmore also feels certain that the late Dr. Irving W. Bailey, similarly, had known nothing of these specimens. Furthermore, a search of Professor Gray's correspondence in the archives of the Gray Herbarium at Harvard, revealed no communication on this matter, with either Dr. Squibb or his pharmaceutical company.

Since accurate taxonomic determinations of these *pareira brava* specimens were not really possible until this year, at least on the basis of comparative stem anatomy alone, it is not surprising that Squibb's queries remained unanswered for more than a century. At the time of my discovery of these materials, fortunately, Dr. Alberta M.W. Mennega (Rijksuniversiteit, Utrecht, The Netherlands) had just published an article on the stem anatomy of the neotropical Menispermaceae (1982), and kindly agreed to identify Squibb's specimens on the basis of their anatomy.

In reference to *pareira brava* shipments from South America, Squibb commented to his son that "within the last half century much of it has come direct and probably many different substances have been sent under the one name." His suspicion had been aroused, in particular, by a recent importation of *pareira brava* from Brazil, to which he alluded in his letter: "On seeing this new lot from Pará, it was so different from anything I had ever seen before that I expressed doubt as to its being the proper

substance." He thereupon advised the importers that this lot was suspiciously different from all previous *pareira brava* imports, and they wrote to Pará for a certificate of authenticity and matching specimen, pertaining to this new shipment. Unfortunately, the exact sample sent with the certificate from Pará is not known (Squibb, 1877: "the piece tied with the green ribbon is one of the three official pieces to which the certificate now applies"), since I was unable to find any green ribbon within parcel No. 1. However, Squibb stated that this certificate also pertained to "samples. . . marked No. 1" (Plate 3). These specimens have been identified as a species of *Abuta*, rather than *Cissampelos Pareira* as stated in the certificate. (Note here that the certificate also refers to these under the vernacular name *"Abutúa"*) Squibb's clarity of perception was truly amazing, especially for one not trained professionally in botany or plant morphology. The samples of his parcel No. 1 were indeed a different genus and species altogether, from what he had previously seen and had regarded "as the true drug"—his specimen parcel No. 4 (below and Table 1). Hence, this large *pareira* shipment (parcel No. 1) was totally different from what both Hanbury (1873) and Squibb considered to be the true *pareira brava*—*Chondodendron tomentosum* Ruiz & Pavón.

Squibb noted that "Specimen No. 2 is from another recent importation" and that "On looking at this in a large open bale a more heterogeneous pile of sticks can hardly be imagined" (Plate 4; Table 1). He also noted that "It has not the uniformity of appearance of the bales of No. 1, but looks as though all 'wild vines' of whatever kind might have been collected and sent to market in one lot". This parcel contains a mixture of both "stem and root", as Squibb had surmised on the label and note included within the parcel, and also had previously commented about other importations of *pareira brava* (1872). Dr. Mennega suspects that this sample No. 2 might be *Cissampelos Pareira*, which the Brazilians appear to have regarded as the *"true pareira brava"*, and in this respect, represented the most nearly authentic of the four specimen parcels which Squibb sent to Harvard. Although Squibb was uncertain as to its authenticity, his observation that Sample No. 1 was more uniform than No. 2 was

TABLE 1.

Pareira Brava Commercial Samples in the Harvard Wood Collection, sent by E. R. Squibb, M.D., in 1877.

Dr. Squibb's Parcel Number	*Harvard Wood Collection #*	*Taxonomic Affinity and Comments**
**No. 1	Aw 33441	*Abuta brevifolia* Krukoff & Moldenke or *A. obovata* Diels, from the Amazon Delta and coastal regions of northern South America; or *A. panurensis* Eichler, from near Manaus, Brazil.
No. 2	Aw 33442	could be *Cissampelos Pareira* L.
No. 3	Aw 33443	most probably *Abuta rufescens* Aublet.
No. 4	Aw 33444	*Sciadotenia* sp.; might be *Sciadotenia cayennensis* Benth., *Sc. paraënsis* (Eichl.) Diels or *Sc. sagotiana* (Eichl.) Diels, all growing in the coastal areas, and much alike in their anatomy.

*Taxonomic affinities and comments courtesy of Dr. A. M. W. Mennega, Rijksuniversiteit, Utrecht, The Netherlands.

**Commercial sample from Squibb to which the certificate of authenticity applies (*see* Plate 2 and Transcription #2).

well-founded, since this sample consists entirely of stem pieces derived from a species of *Abuta* (Plate 3).

Squibb's Specimen parcel No. 3 is "the *Pareira Brava* of the N.Y. market about 1865 to 1869", and he noted that "when black pieces appeared among these about 1869, they were at first supposed to be a different substance"; however, he soon realized that this earlier lot had been a mixture of "stem and root", whereas the more recent, parcel No. 3 contained only pieces of the stem (cf. Squibb, 1872). In his note which accompanied this individual parcel, Squibb accurately referred to the material as what he "supposed to be the woody stem of true *Pareira Brava*". Dr. Mennega noted that this is probably *Abuta rufescens*, a liana often referred to as "*Pareira brava rouge*". This species also had been described by Hanbury (1873) as a third "sort" of *pareira brava*, but one which he had never seen in commerce. It appears as though Squibb, similarly, had never encountered this species in the market, since he made no mention of it as one

possible origin for *pareira brava*, either in his publication (1872) or the letter to his son (1877).

Dr. Squibb considered Specimen parcel No. 4 "as the true drug, and the desireable part of the plant for medicinal uses". Although he was uncertain as to the exact botanical origin of true *pareira brava*, he apparently considered this sample to be either *Cissampelos Pareira*, or the *Chondodendron* described by Hanbury (loc. cit.). Dr. Mennega, however, identified this sample as a species of *Sciadotenia*. I have found no reference in the literature to this genus as a commercial source of *pareira brava*, although it is sometimes used in curare (Krukoff and Smith, 1937, 1939). Since this genus may be substituted for other menispermaceous taxa in curare preparation, such as *Abuta* and *Chondodendron*, Squibb's parcel No. 4 may have been collected by Brazilian natives of the Amazon basin as a saleable substitute for the "*true pareira*". As noted previously, different genera and species of Menispermaceae, used in curare preparation throughout the Amazon, often are referred to by the natives under the same common name. It is very interesting that Squibb refers to this lot as the drug "commonly met with in the N.Y. market from 1865 to 1869". Perhaps the apparently fraudulent nature of this material can account for the "set of very feeble preparations", made from imports of the drug during this period, to which Squibb alluded in his letter of 1877.

More than a century later, we can now answer Dr. Squibb's major queries regarding these various importations, as originally presented to Goodale and Gray: (1) "whether the compact and spongy pieces of 2, 3 and 4 really belong to the same plant, or not", (2) "and if so whether it be as root and stem as I had supposed", (3) "whether No. 1 is the same or a different plant,— or what it really is.", (4) "Whether the certificate amounts to anything", and (5) "whether this be not really *Cissampelos*, when we require not that, but *Chondodendron*".

To his first question the answer is clearly "No"; these three samples belong not only to different species, but also to *three different genera* of Menispermaceae (Table 1). Secondly, both "root and stem" appear only in parcels No. 2 (*Cissampelos Pareira;* Plate 4) and No. 4 (*Sciadotenia* sp.; Plate 6), while only

stem pieces are included within parcel No. 3 (*Abuta rufescens* = *"pareira brava rouge"*; Plate 5). Thirdly, sample No. 1 from Dr. Squibb is not the same plant as contained in the other three parcels, and although it is congeneric with parcel No. 3, it appears to be a different species of *Abuta* from that of parcel No. 3 (Plates 3–6; Table 1). Whether the certificate of authenticity really amounted to anything or not remains unclear, since the piece with the green ribbon was not located in parcel No. 1. If Squibb and the importers were correct, however, in their belief that Specimen parcel No. 1 and the certified piece with the green ribbon were of the same material shipped from Pará, then the certificate was invalid, at least with regards to botanical taxonomy. The certificate claimed that this material was *Cissampelos Pareira*, when in fact it is a species of *Abuta*.

Perhaps the most amusing and ironic fact, in regard to Squibb's final question, is that none of the material in his shipment to Harvard belongs to the genus *Chondodendron*. To my knowledge, the only species of curare-plants of the Menispermaceae ever exploited commercially by E.R. Squibb & Sons, Inc. is *Chondodendron tomentosum*, the preferred source of d-tubocurarine. Although E.R. Squibb seems to have had the keen eye of a professional botanist and the pharmacognostic insight of a 19th century physician,—in suspecting that the *pareira brava* which he and his colleagues really required was *Chondodendron* rather than *Cissampelos*,—he appears never to have received any specimens of what modern botanists consider to be genuine *pareira brava*, from either Europe or South America.

ACKNOWLEDGEMENTS

Many thanks are due to Dr. Alberta M.W. Mennega (Rijksuniversiteit, Utrecht, The Netherlands) for her kind cooperation and prompt taxonomic determination of Squibb's commercial specimens of *pareira brava*. I am also grateful to Professor Richard Evans Schultes (Director, Harvard Botanical Museum) for his encouragement and for financing the preparation of photographic plates, with a grant from the National Institutes of Health, for research on the Ethnopharmacology of the north-

west Amazon. This study was completed by the author while supported as a Katherine Atkins Postdoctoral Fellow in Tropical and Economic Botany at Harvard University.

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_____. 1877. A letter written to his son, E. H. Squibb (Transcription #1 and Plate 1, herein), which is located in the Harvard University Wood Collection, Botanical Museum, Cambridge, MA.

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APPENDIX

Transcription #1: Letter from E. R. Squibb, M.D. of Brooklyn, N.Y. to his son, E. H. Squibb of Cambridge, Mass., concerning four parcels of "Pareira Brava" sent with the letter for taxonomic determination by Professors Goodale and Gray of Harvard University. April 10, 1877.

E. R. Squibb, M.D. Brooklyn April 10, 1877
Brooklyn, N.Y.

E. H. Squibb
Cambridge

My dear son,

By express today I send a parcel containing specimens of the drug called Pareira Brava, which I offer for acceptance by Drs. Goodale or Gray and I would very much like to have the opinion of one or the other of these gentlemen on a single point which I will try to make clear, and try to show the importance of in the following outline sketch.

This drug in common with many others reached France and England through Portugal from South America; and by its utility in affections of the mucouslinings of the kidneys and bladder it became a well established article of the materia medica nearly two centuries ago. And it has retained that reputation without much modification ever since, and probably will retain it if the identity and integrity of the substance can be protected against cupidity. Its reputation came to us from Great Britain, and the best parcels of the drug have always reached us from either the London, or north German markets, but there always at a high price compared with that sent for and obtained directly from South America. Hence within the last half century much of it has come direct, and probably many different substances have been sent under one name. Under these conditions (overleaf) its reputation can derive and it was in danger of being lost through want of knowledge in discriminating the character and quality of substances sent under the name "Pareira Brava". I myself was for many years in the obscurity of ignorance in regard to it and almost accidentally became aware of my ignorance. In 1871 I published a note on the subject in the Proceedings of the American Pharmaceutical Association. This was copied into the American Journal of Pharmacy for March 1872 and will be found on page 107 of the volume for 1872.

In 1873 Daniel Hanbury reexamined the subject in a paper which will be found in the London Pharm. Journal and Trans. for 1873, Vol. IV, p. 81-102. This paper was extensively republished,

and is found in the volume of "Science Papers, D. Hanbury", published since his death.

What I believed to be stem and root of the same plant, Hanbury *seems* to regard as being from different plants, the one a spurious drug, the other the true one.

My own experience and his paper have served to keep me in a certain track since 1870, and I have only used what I considered to be the true root as described by Pomet, "History of Drugs", rejecting what I considered as the woody stems. Prior to 1868 when I used the woody stems, and did not know the part since used, a set of very feeble preparations resulted of which I never knew anything good or bad. But since that time, when only the part which I perhaps mistakenly considered to be the root, but which is without much doubt the substance described by the older writers,—the fluid extract made from this, has been used to a very considerable extent, by many pretty close observers of therapeutic effects, with pretty definite good results, so that the drug after having declined in reputation and in usage for many years, has now for the past two or three years been again growing into favor especially in the treatment of that very troublesome class of cases which unless well managed degenerate into incurable chronic inflammation of the bladder.

As it now is growing in favor, the importers of drugs are on the alert for the profits, and accordingly two months ago a shipment of "*Pareira Brava*" appeared in this market direct from Pará,—the market being previously supplied by a rather curious mixture, in large quantity, - not in the characteristic baskets,—but simply in bagging. On seeing this new lot from Pará it was so different from anything I had ever seen before that I expressed doubts as to its being the proper substance. As the importers had full confidence in their drug, and in the correspondent who sent it, and yet had some respect for my judgement, and the effect it might have on their market for their shipment, they wrote out to Pará in regard to it, and have just received a very formidable looking certificate verified by consular certificate,—as to the character of the importation. At my request they have given me a copy of the material parts of this certificate, and this I enclose here within. The samples of this substance are marked No. 1 and the piece tied with green ribbon is one of three official pieces to which the certificate (overleaf) now applies, and which accompanied the certificate. The other pieces marked No. 1 are from the large shipment. The yellow color and bitter taste of this substance seems to be due to berberina. The taste is quite different from that of the specimens which I have supposed to be the true *Pareira Brava*. Is this Cissampelos as stated, and the other Chondodendron of Hanbury?

Specimen parcel No. 2 is from another recent importation, large quantities of which are now in the market. On looking at this in a large open bale a more heterogeneous pile of sticks can hardly be

imagined, or one which from appearance could be less adapted to anything like accurate medication. It has not the uniformity of appearance of the bales of No. 1 but looks as though all "wild vines" of whatever kind might have been collected and sent to market in one lot. A very large proportion of the whole however is on close examination found to be either hard, compact, and comparatively tasteless pieces, or light brown color externally, or the nearly black spongy (stringy?) pieces, such as I formerly supposed to be the stems and roots of the same plant, and that the true *Pareira Brava*.

Specimen parcel No. 3 is the *Pareira Brava* of the N.Y. market about 1865 to 1869, and when the black pieces appeared among these about 1869, they were at first supposed to be a different substance, see Amer. Jour. Pharm. Mar. 1872 p. 107. On referring to the older writers however the black pieces were supposed to be the true drug, and these to be stems of the same plant.

Specimen parcel No. 4 is what I regard as the true drug, and the desireable part of the plant for medicinal uses. And the small internal parcel contains what I consider to be typical specimens of the required part.

Now what I hope for in referring this matter to Drs. Goodale or Gray, is, that Structural Botany may be able to decide first whether the compact and spongy pieces of 2, 3 and 4 really belong to the same plant or not, and if so whether it be as root and stem, as I had supposed.

"second, whether No. 1 is the same of a different plant, or what it really is. Whether the certificate amounts to anything, and if it does whether this be not really Cissampelos, when we require not that, but Chondodendron.—And what I most desire too, is not to tax the time of either of the gentlemen too far.

No signature—End of page

Transcription #2. Certificate of authenticity presented to E. R. Squibb by Lehn & Fink, Importing and Jobbing Druggists of New York, pertaining to the recent importation of Pareira Brava from Pará, Brazil. Dated February 23, 1877. (pertaining to Squibb's specimen parcel No. 1)

LEHN & FINK.
Importing and Jobbing Druggists
160 William Street

P.O. Box 3114 New York, _____ 187___

Copy of a Certificate of examination of a lot of Pareira Brava, shipped from Pará, Brazil to Lehn & Fink New York in March 1877.

Pará February 23rd, 1877

I, Dr. Francisco da Silva Castro, Commander of the Imperial Order of the Rose, Chevalier of the order of Christ, Commander etc etc etc Member of the Royal Academy of Science of Stockholm etc etc Inspector of Public Health of the Province of Gran Para etc etc

Certify that the pieces or fragments of the Vegetable, which has been handed to me by Mess.: Elpidio R. da Costa & Co., Chemists established in this Capital in the Chemistry Shop known as: "Pharmacia Minerva" and which are the true and genuine Abútua, of the wild forests of this province.

This vegetable belongs to the family of the Menispermeas, and its botanical or technical name is "Cissampelos Parreira", that of "Abútua" is the most common and usual; the Indians call it "Caápeba" in the tupy languages and the Villagers "Cipo de Cobra". The ancient Portugeses (over) called it "Parreira Brava" and the Jesuit Missionaries "Cipo de Nossa Senhora". In some of the southern Provinces it is called "Oretha de Onca".

There are different varieties all of them however possessing the same powers and medicinal properties, well studied and known in science. etc etc

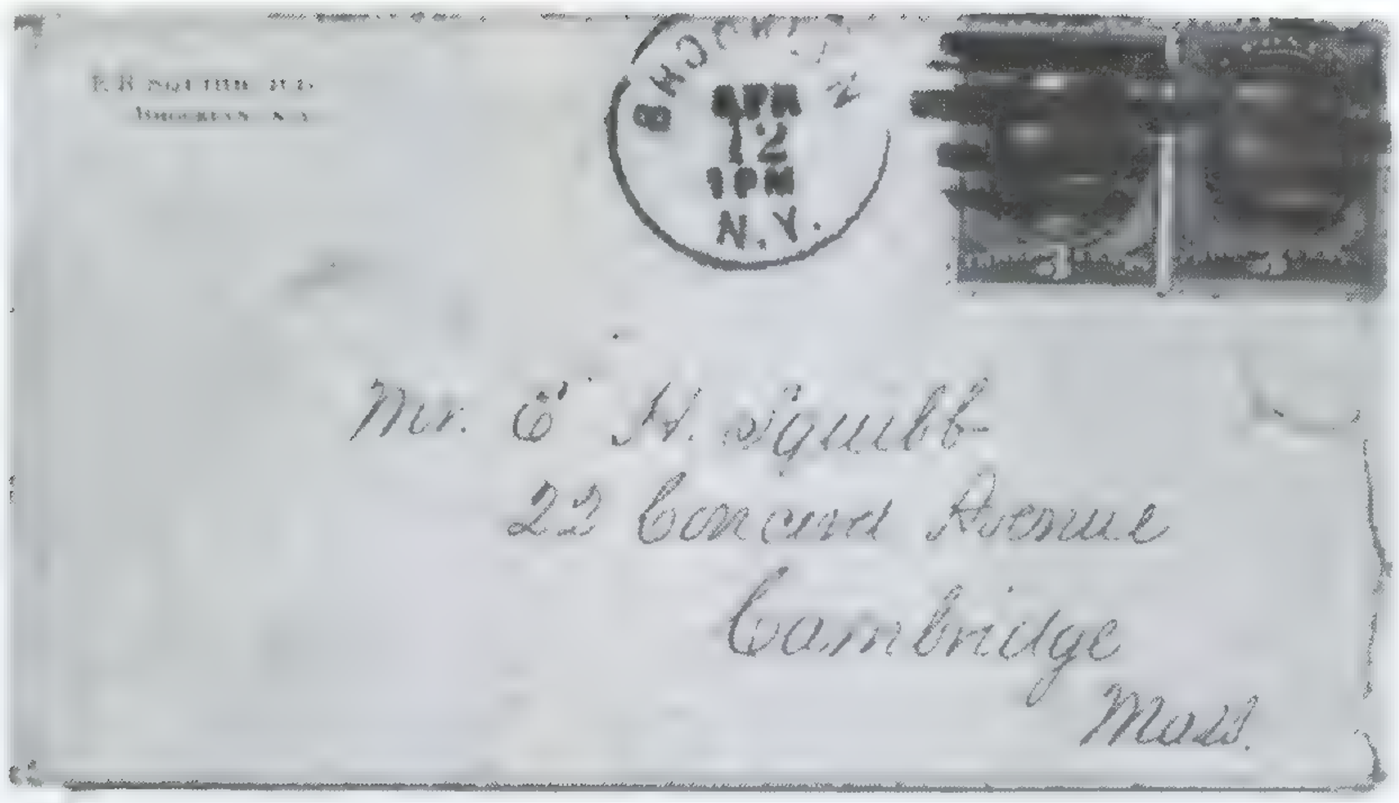
signed Dr. F. dS.C.

(Consul's certificate accompanied
by Andrew Cone, Pará, March 15, 1877)

Submitted for kind perusal to
E. R. Squibb, M.D.

Respectfully,
Lehn & Fink

PLATE 1



E. R. Squibb, M.D.
Brooklyn N. Y.

APR 12 1PM N.Y.

Mr. E. H. Squibb
22 Concord Avenue
Cambridge
Mass.

E. R. Squibb, M.D.
Brooklyn N. Y.

Brooklyn April 10th 1877

E. H. Squibb
Cambridge

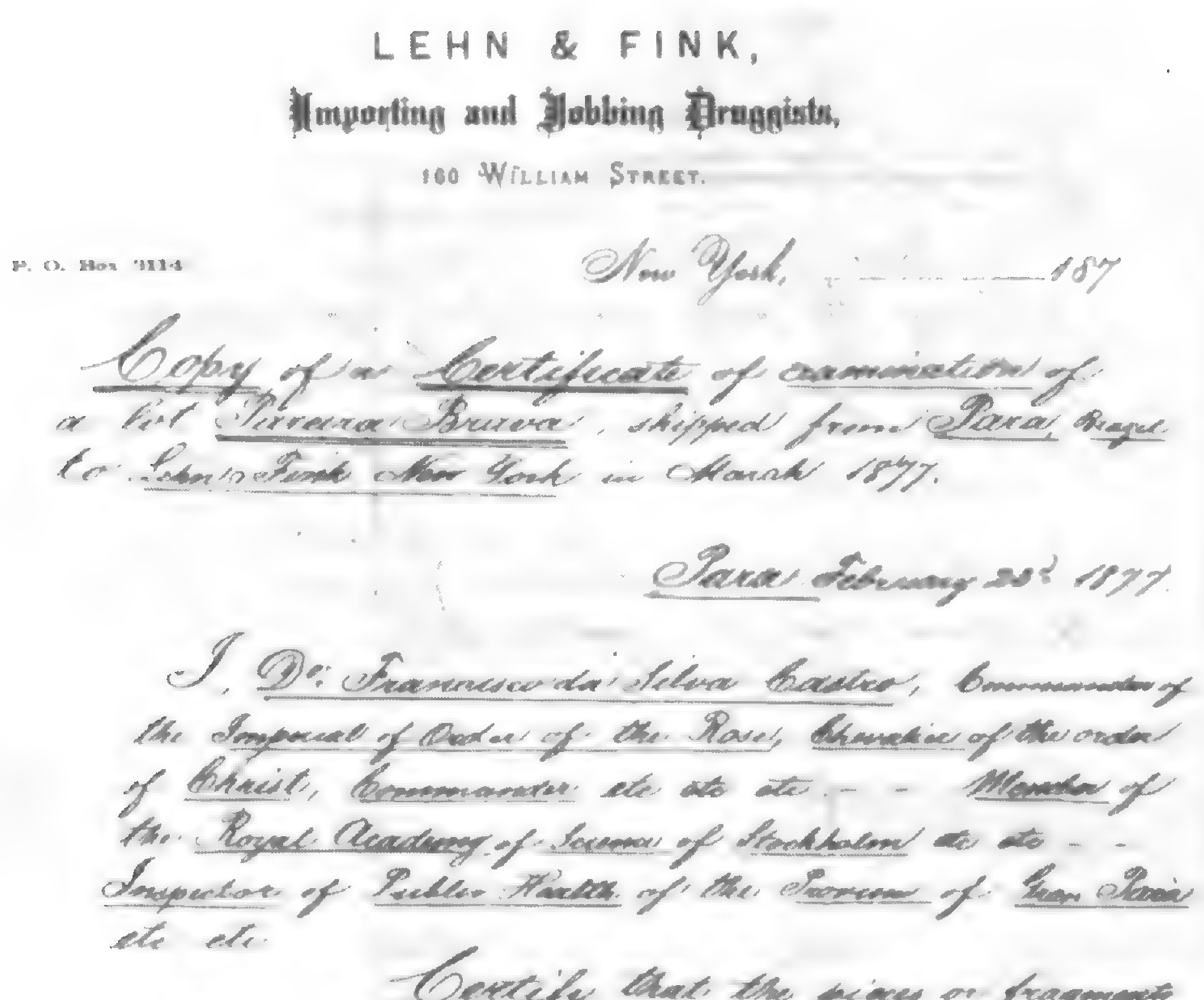
My dear Son

I [illegible] to-day, and a parcel containing specimens of the drug called Cusco Bark which I offer for acceptance by the Faculty of Columbia College. And I should like to have a specimen of one or the other of these gentlemen as a sample, and also I should like to make them, and by them the profession generally, acquainted with the existence of the drug.

I am doing as much with it as I can. I have used Squibb's Extract of Sarsaparilla with the happiest results in all cases of the various forms of the disease and find it beneficial in all of the various forms in which it is exhibited in all of the various cases, but I find that it is much more active, as a tonic, and possesses all the properties of the bitters, and antiseptic properties of the sarsaparilla. I have come to the conclusion that the best parts of the drug have not reached us from either the London, or Squibb's Extract, but that which I have used and obtained directly from South America. I have written Dr. Ford [illegible] about it, but I have not been able to see him. I find that the drug has been used under the name of [illegible]

Plate 1. Original letter and envelope from E. R. Squibb, M.D., to his son, E. H. Squibb. Dated April 10, 1877. (See complete letter transcription on previous pages.)

PLATE 2



LEHN & FINK,
Importing and Jobbing Druggists,
160 WILLIAM STREET.

P. O. Box 3114

New York, _____ 187

Copy of a Certificate of examination of a lot Pereira Brava, shipped from Para Brazil to Lehn & Fink New York in March 1877.

Para Febreiro 23d 1877.

I, Dr. Francisco da Silva Castro, Commander of the Imperial of Order of the Rose, Chevalier of the order of Christ, Commander etc etc etc - - Member of the Royal Academy of Science of Stockholm etc etc - - Inspector of Public Health of the Province of Gran Para etc etc.

Certify that the pieces or fragments of the Vegetable, which has been handed to me by Mess Elpidio R. da Costa & Co, Chemist established in the Capital in the Chemistry Shop known as "Pharmacia Mineira" and which are sealed with the Seal of my name are of the true and genuine Abuta, of the wild forests of this province.

This vegetable belongs to the family of the Menispermeas and its botanical name is Cissampelos Pareira that of "Abuta" is the most common and usual, the Indians call it "Caapeba" in the Tupy language and the Villagers "Caapé da Cobra". The ancient Portuguese

Plate 2. Certificate of authenticity given to E. R. Squibb, M.D., by Lehn & Fink, Importing and Jobbing Druggists of New York, identifying Squibb's specimen parcel No. 1 as *Pareira Brava*, derived from *Cissampelos pareira* L. Dated on February 23, 1877. (See transcription on page 42.)

PLATE 3

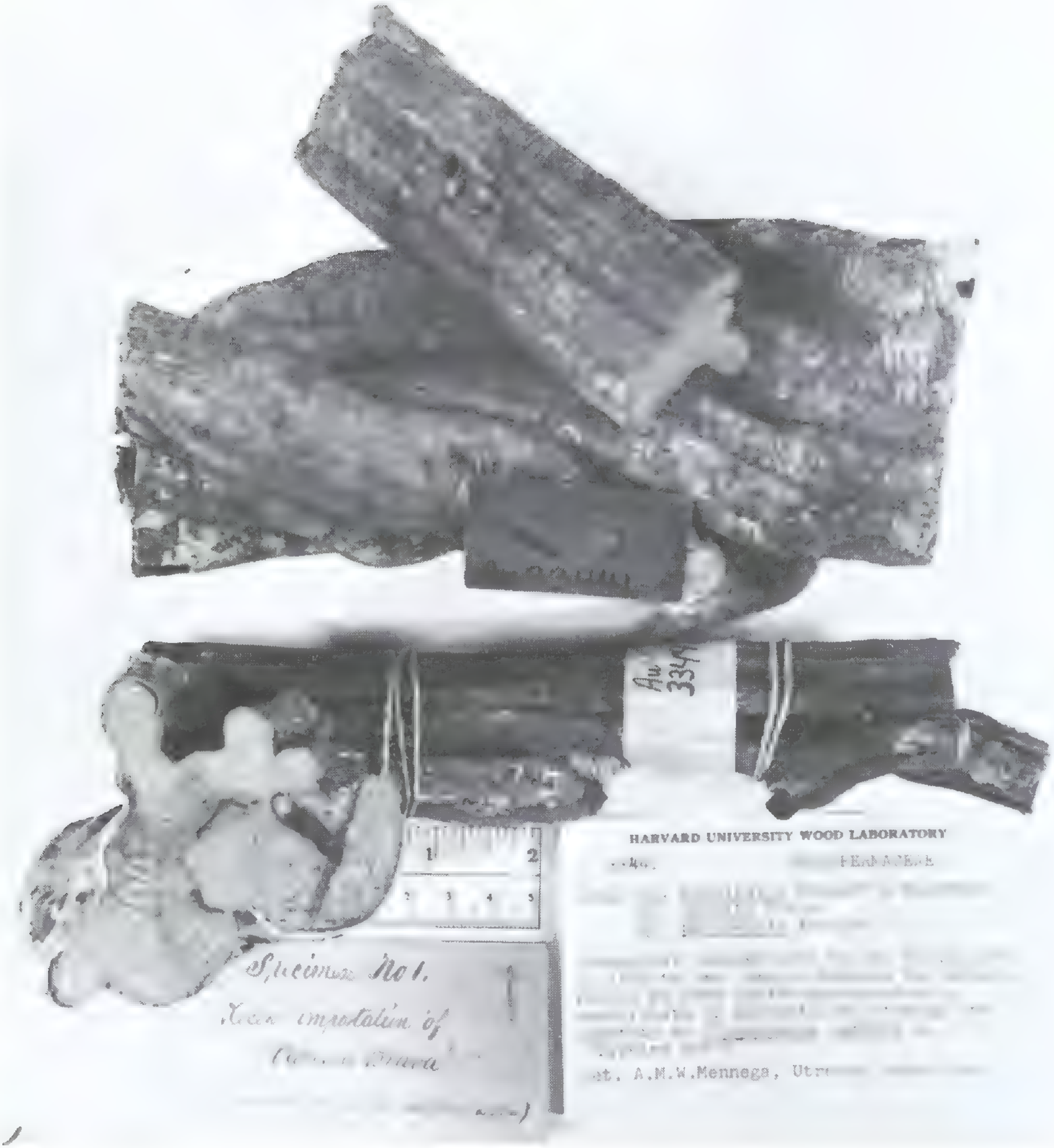


Plate 3. *Pareira Brava:* Squibb's specimen parcel No. 1, from an 1877 importation from Pará, Brazil, and accompanied by a copy of the certificate of authenticity (Plate 2), stating this plant as belonging to *Cissampelos pareira.* ACTUAL IDENTITY: *Abuta* sp. (Aw 33441)

PLATE 4

HARVARD UNIVERSITY WOOD LABORATORY

Plate 4. *Pareira Brava:* Squibb's specimen parcel No. 2, from an 1877 importation, consisting of both "stem and root" as noted by Squibb. ACTUAL IDENTITY: aff. *Cissampelos pareira* L. (Aw 33442)

PLATE 5

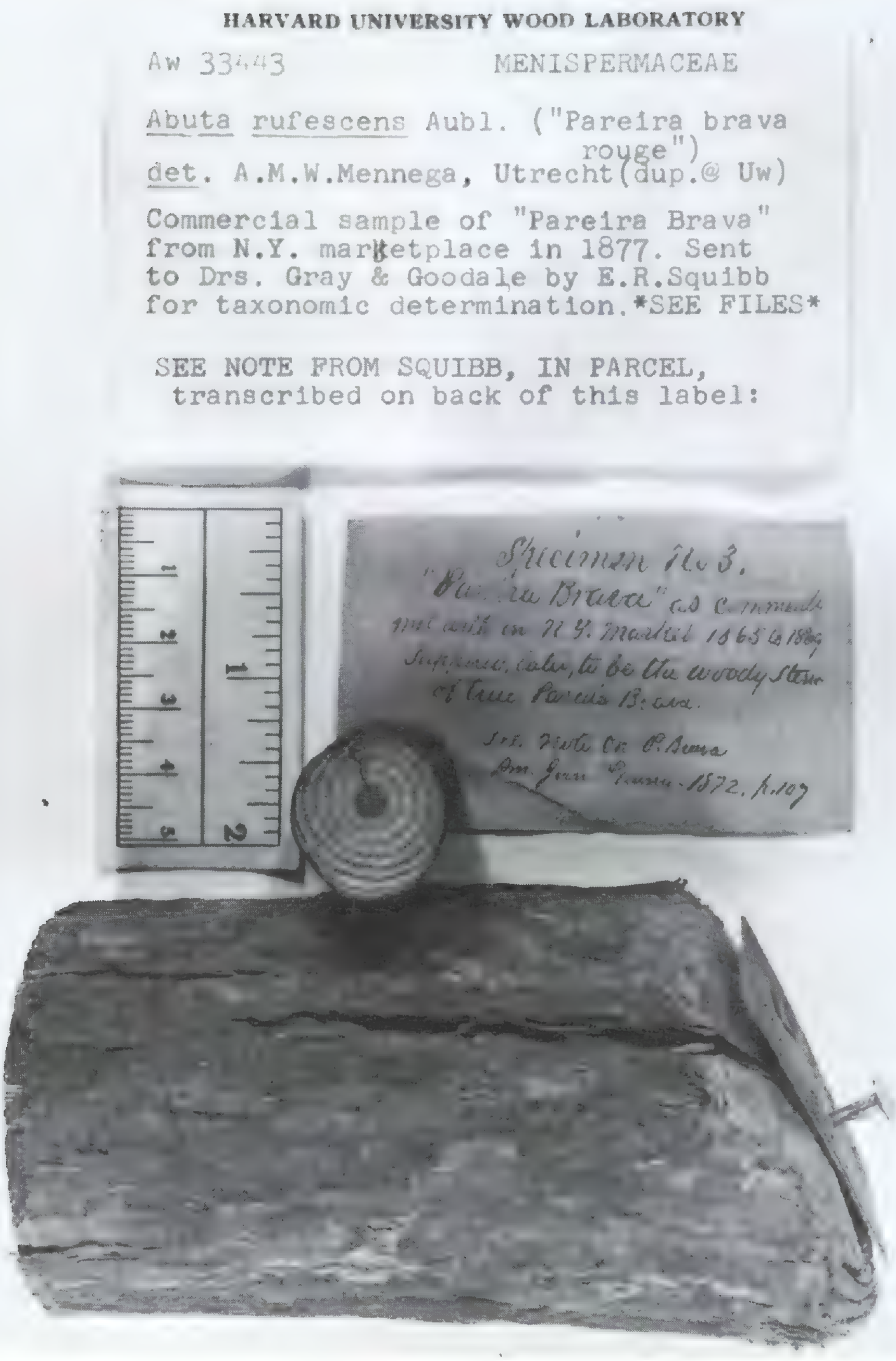


Plate 5. *Pareira Brava*: Squibb's specimen parcel No. 3, to which Squibb referred as "the *Pareira Brava* of the N.Y. market about 1865 to 1869" and considered to be pieces of "the woody stem". ACTUAL IDENTITY: *Abuta rufescens* Aublet, "*Pareira brava rouge.*" (Aw 33443)

PLATE 6

Aw #: 33444 MENISPERMACEAE

Sciadotenia sp. (cf. S. cayennensis
S. paraensis(Eichler)Diel

Collection/Voucher: Commercial sample sent in 1877 -s)

Locality: from Para, BRASIL to Dr.E.R.Squibb in NY, then by Squibb to Drs. Gray & Goodale for taxonomic determination on 4/10/1877.*SEE FILE Squibb's parcel #4--supposed to be "Pareira Brava" (Cissampelos pareira L.) - see note from Squibb in parcel with sample.

Liq. Preserved: Det. A.M.W.Mennega, Utrecht (dup.@Uw)

Dried Wood: X

Slides:

Notes:

Plate 6. *Pareira Brava:* Squibb's specimen parcel No. 4, to which he referred as "the true drug, and the desireable part of the plant for medicinal uses". ACTUAL IDENTITY: *Sciadotenia* sp. (Aw 33444)

BOTANICAL MUSEUM LEAFLETS
WINTER 1983

VOL. 29, NO. 1

DE PLANTIS TOXICARIIS E MUNDO NOVO TROPICALE COMMENTATIONES XXX

BIODYNAMIC GUTTIFEROUS PLANTS OF THE NORTHWEST AMAZON

RICHARD EVANS SCHULTES

Plants with latex or resins seem to be accorded a special consideration as medicinals among the Indians of the northwest Amazon. Representatives of the Guttiferae appear to be repeatedly pointed out as therapeutic plants, the primary applications often being associated with their latex or resin content.

The following species were indicated as having medicinal or toxic use by Indians of the northwest Amazon during my fourteen years of field work in this area.

The species of Clusia and several other genera have been identified by Dr. Bassett Maguire of the New York Botanical Garden. The collections cited below are preserved in the Economic Herbarium of Oakes Ames or in the Gray Herbarium, both at Harvard University, the New York Botanical Garden and/or the Herbário Nacional in Bogotá. The genera are arranged alphabetically.

Caraipa laxiflora *Bentham* in Hooker, Lond. Journ. Bot. 2 (1843) 364.

BRAZIL: Estado do Amazonas, Middle Rio Negro, between the mouth of Rio Curicuriari and Barcellos, Vista Alegre. September 26–October 14, 1947. *Schultes et López 8867.*
COLOMBIA: Comisaria del Vaupés, Río Apaporis, Raudal Yayacopi. "Small tree, 10–12 feet. Fruit brown." February 15, 1952. *Schultes et Cabrera 15363.*

The Puinave Indians of Colombia know this plant as *kar-pat'*; the Kubuyari as *ma-wan-he-te*. The Indians of the middle Río Apaporis basin apply the sap to cure fungal diseases of the skin.

Caraipa parvielliptica *Cuatrecasas* in Rev. Acad. Col. Cienc. 8, no. 29 (1950) 64.

COLOMBIA: Comisaria del Vaupés, Río Kananarí, Cerro Isibukuri. "Bush along rill." April 12, 1951. *Schultes et Cabrera 14738.*—Río Miritiparaná. August 5, 1952. *Schultes et Cabrera 16460.*

Comisaria del Amazonas, Río Apaporis, Soratama. March 26, 1952. *Schultes et Cabrera 16070.*

The crushed leaves of *Caraipa parvielliptica* are rubbed vigorously on irritated skin for relief from itching among the Taiwano Indians.

A similar use is made of *Caraipa grandifolia* Mart. in the Brazilian Amazon, where the sap is considered to be an excellent treatment for "herpes, mange and itching" [LeCointe: *A Amazonia Brasileira* (1934) 424].

Clusia amazonica *Planchon et Triana* in Ann. Sci. Nat., ser. 4, 13 (1860) 358.

COLOMBIA: Comisaria del Amazonas, Río Apaporis, Soratama. "Strangler. Fruit ripens black-purple. No latex. Flood-bank." June 26, 1951. *Schultes et Cabrera 12834.*—Río Miritiparaná, Caño Guapayá. "Scandent shrub, extensive, fruit yellow but reddening from base to tip. No latex in stem. Latex of peduncle white." May 8, 1952. *Schultes et Cabrera 16386.*—Río Amazonas near mouth of Río Loretoyacu. "Scandent epiphyte. Flowers orange-white." September 13–15, 1966. *Schultes, Raffauf et Soejarto 24143.*

Comisaria del Vaupés, Río Apaporis, Jinogojé. "On savannah. Parasitic. July 7, 1951. *Schultes et Cabrera 12966.*—Same locality." Vine. Fruit ripening red. Latex watery. June 20, 1952. *Schultes et Cabrera 16765.*

The Makuna call this vine *ree-ka-ne-to-ma;* the Puinave know it as *pap-ka'*; in Yukuna, the name is *ka-hee-wa'-ka.* The fruits, boiled in water, yield a tea which is considered to be an excellent diuretic.

Clusia chiribiquetensis *Maguire ex R. E. Schultes* in Bot. Mus. Leafl., Harvard Univ. 15 (1951) 56, t. 18.

COLOMBIA: Comisaria del Vaupés, Río Macaya, Cerro Chiribiquete. January 1944. *Gutiérrez et Schultes 677.*—Same locality and date. "Bush 7 8 feet tall." *Gutiérrez et Schultes 679.*—Same locality. "Large, scraggly shrub 10 feet high; latex yellow, sticky; flowers white; sepals red-purple." May 15–16, 1943. *Schultes 5473.*—Same locality. July 24, 1943. *Schultes 5623.*

Among the Karijonas of the upper Vaupés, *Clusia chiribiquetensis* is reported as an effective antifungal agent: the fleshy, resinous leaves are crushed and applied to raw sores on the legs and feet that seem to be primarily of fungal origin. The plant is known by the Karijona name *ta-te'-pe-ka-me.*

Clusia columnaris *Engler ex Martius,* Fl. Bras. 12, pt. 1 (1888) 432.

COLOMBIA: Comisaria del Vaupés, Río Apaporis, Cachivera de Jirijirimo. "Small tree, 10 feet tall. Flowers white. Latex white. Basal half of petals deep purple-maroon. Fragrant. June 11, 1951. *Schultes 12360.* Same locality. September 16, 1951. *Schultes et Cabrera 14000, 14015, 14037, 14061, 14085.*— Same locality. January 21, 1952. *Schultes et Cabrera 14966.*—Río Vaupés, Mitú and vicinity. September 7, 1951. *Schultes et Cabrera 138951;* - Río Kuduyarí, Cerro de Yapobodá. October 5, 1951. *Schultes et Cabrera 14245, 14371.*—Río Piraparaná, Raudal Na-hoo'-gaw-he. "Large tree on rocks. Latex white. Flowers white, centre reddish purple." August 30, 1952. *Schultes et Cabrera 17099.*—Río Kubiyú, Cerro de Kañendá. November 10, 1952. *Schultes et Cabrera 18312, 18373.*

Comisaria del Amazonas, Río Caquetá, La Pedrera. "Fruit red." April 1944. *Schultes 5865.*—Río Apaporis, Soratama. August 16, 1951. *Schultes et Cabrera 13586.*

Among many Indians of the Vaupés, the juice or latex of this very abundant treelet is employed to relieve toothache.

The Barasana Indians call this tree *dee-ka'-da* or *nee-ka'-da;* the Kubeos know it as *be-bam;* the Makús of the Río Piraparaná refer to it as *ree-ka-re-to-mee-see-ma-ma* ("vine that covers the flowers").

Clusia columnaris *Engler* var. **vaupesana** *Cuatrecasas* in Rev. Acad. Col. Cienc. 8, no. 29 (1950) 41, t.1.

COLOMBIA: Comisaria del Vaupés, Mitú and vicinity, savannah at base of Cerro de Mitú. September 27 October 20, 1966. *Schultes, Raffauf et Soejarto 24213.*—Urania. Same date. *Schultes, Raffauf et Soejarto 24321.*

This variety is alkaloid-negative with a Dragendorff spot test.

Clusia Gaudichaudii *Choisy ex Planchon et Triana* in Ann. Sci. Nat., ser. 4 13 (1860) 331.

COLOMBIA: Estado do Amazonas, Rio Negro, Tapurucuara. September 26 October 9, 1947. *Schultes et López 8910.* Same locality and date. "Strangler epiphyte. Flowers dark red." *Schultes et López 8926.*

The juice of the crushed leaves is applied to the gums to relieve toothache among the inhabitants of the middle course of the Rio Negro of Brazil, where the plant is called *apuí*.

Clusia globosa *Maguire ex R. E. Schultes* in Bot. Mus. Leafl., Harvard Univ. 15 (1951) 60.

COLOMBIA: Comisaria del Amazonas, Trapecio Amazónico, Río Boiauassú. November 1945. *Schultes 6790.* Río Amazonas, vicinity of Leticia. August 29 September 12, 1966. *Schultes, Raffauf et Soejarto 24009.* Same locality and date. *Schultes, Raffauf et Soejarto 24109.*

A spot test with Dragendorff reagent was alkaloid-negative for *Schultes, Raffauf et Soejarto 24009*, doubtfully positive for *24109.*

Clusia insignis *Martius*, Nov. Gen. et Sp. 3 (1829 32) 164, t. 288.

COLOMBIA: Comisaria del Vaupés, Río Negro, opposite Piedra del Cocuí. "Enormous tree, 75 feet tall, 18 inches in diameter, columnar. Wood reddish towards centre, yellow-white nearer surface, very hard. Leaves thick. Flowers extraordinarily showy, purple-red, 5 inches across, smelling like rancid butter. In caatinga." December 17, 1947. *Schultes et López 9520.* Río Vaupés, summit of Cerro Mitú. September 27 October 20, 1966. *Schultes, Raffauf et Soejarto 24343.*

The curious odour of the flowers notwithstanding, the natives of the upper Río Negro of Colombia value the resin of the plant for treating toothache.

Clusia Lopezii *Maguire ex R. E. Schultes* in Bot. Mus., Leafl., Harvard Univ. 15 (1951) 61.

COLOMBIA: Comisaria del Vaupés, Río Negro at confluence of Ríos Guainia and Casiquiare, Caño Ducuruapo (Igarapé Rana). December 13 17, 1947. *Schultes et López 9388.* Río Negro, vicinity of Piedra del Cocuí. December 17, 1947. *Schultes et López 9473.* Río Kuduyarí, Yapobodá. October 24, 1951. *Schultes et Cabrera 14198c.*

The resinous exudate of *Clusia Lopezii* is applied to deep dental caries to relieve toothache.

Clusia microstemon *Planchon et Triana* in Ann. Sci. Nat., ser. 4, 13 (1860) 331.

COLOMBIA: Comisaria del Amazonas, Río Igaraparaná, La Chorrera. June 4 10, 1942. *Schultes 3975.* Río Amazonas, vicinity of Leticia. August 29 September 12, 1966. *Schultes, Raffauf et Soejarto 24014.*

Comisaria del Vaupés, Río Apaporis, Raudal Yayacopi. "Epiphyte. Flowers white, purple centrally. Latex thin, white." August 18, 1952. *Schultes et Cabrera 16954*. Río Vaupés, Mitú and vicinity. September 27 October 20, 1966. *Schultes, Raffauf et Soejarto 24295*. Same locality and date. *Schultes, Raffauf et Soejarto 24306*.

The Witoto Indians of the Río Igaraparaná value the thin latex of *Clusia microstemon* to deaden toothache: it is applied to the tooth and gums with the finger. The Makunas of the Río Apaporis rub the crushed leaves on muscular sprains, stating that the "heat from the leaves" relieves pain.

The collections *Schultes, Raffauf et Soejarto 24295* and *24306* are alkaloid-negative with a Dragendorff reagent spot-test.

Clusia opaca *Maguire ex R. E. Schultes* in Bot. Mus. Leafl., Harvard Univ. 15 (1951) 62.

COLOMBIA: Comisaria del Vaupés, Río Kananarí, Cerro Isibukuri. "Six feet tall." October 29, 1951. *Schultes et Cabrera 14503*.—Same locality. "Bush 9 feet tall. Fruit reddening when ripe. Latex colourless. Common on summit." December 4, 1951. *Schultes et Cabrera 14733*.—Same locality. "Three feet tall. Latex colourless, coagulating yellow." January 23–25, 1952. *Schultes et Cabrera 15049*.

These collections are the first records of *Clusia opaca* for the flora of Colombia.

The resinous bark of *Clusia opaca* is dried in the sun by the Taiwano Indians and pulverized; mixed with oil from the palm *Jessenia Bataua*, it is applied to sprains and aching joints.

Clusia penduliflora *Engler ex Martius*, Fl. Bras. 12, pt. 1 (1888) 412, t. 84, fig. 2.

COLOMBIA: Comisaria del Vaupés, Río Macaya, near Cachivera del Diablo. Alt. c. 300 m. "Vine. Fruits red." May 1943. *Schultes 5521*.

The Karijona Indians crush the leaves of this species of *Clusia* to poultice on open cracks and sores of the feet which seem to be of fungal origin.

Clusia Planchoniana *Engler ex Martius*, Fl. Bras. 12, pt. 1 (1888) pl. 93, fig. 1.

COLOMBIA: Comisaria del Vaupés, Río Guainía, Puerto Colombia, opposite Maroa. "Large bush. Flowers white outside, dark red inside. Latex colourless." October 31–November 2, 1952. *Schultes, Baker et Cabrera 17938*.

The resin of this large bush is applied to the gums to relieve toothache among the Kuripako Indians of the Río Guainía.

Clusia renggerioides *Planchon et Triana* in Ann. Sci. Nat., ser. 4, 13 (1860) 350.

COLOMBIA: Comisaria del Amazonas, La Chorrera, Río Igaraparaná. "Strangler. Petals red-purple." June 4–10, 1942. *Schultes 3940.* Comisaria del Vaupés, Cerro La Campana, Río Ajaju. June 1–6, 1943. *Schultes 5565.*—Río Piraparaná, Caño Teemeeña. September 6, 1942. *Schultes et Cabrera 171244.*

An infusion of the flowers of *Clusia renggerioides* is valued among the Witotos of the Río Igaraparaná as an antidysenteric.

Clusia Schultesii *Maguire et R. E. Schultes* in Bot. Mus. Leafl. Harvard Univ. 15 (1951) 65.

COLOMBIA: Comisaria del Vaupés, Río Macaya, Cerro Chiribiquete. July 24, 1943. *Schultes 5621.*—Same locality. May 15 16, 1943. *Schultes 5475.*

The Indians of the upper Vaupés believe that the crushed leaves of *Clusia Schultesii,* when poulticed on sores of the feet, hasten healing.

Clusia spathulaefolia *Engler ex Martius,* Fl. Bras. 12, pt. 1 (1888) 412.

COLOMBIA: Comisaria del Vaupés, Río Vaupés, Cerro Circasia. "Scandent shrub. Fruit in pendant clusters." March 7, 1944. *Schultes 5847.* Río Apaporis, Cachivera de Jirijirimo. Tree 20 feet. Trunk 4 5 inches. Leaves coriaceous, revolute, pale yellow-green beneath. Fruit clustered, reddening. Latex slightly yellow." June 11, 1951. *Schultes et Cabrera 12364.*—Same locality. June 13, 1951, *Schultes et Cabrera 12466, 12468, 12472.*—Same locality. "In low forest, highland, sandy soil. Tree 6 m. Latex white, abundant." July 5, 1951. *Schultes et Cabrera 12938, 12939.*—Same locality. "Savannah. Bush 3 m. high. Latex white, sparse." July 7, 1951. *Schultes et Cabrera 12948.*—Río Vaupés, base of Cerro Mitú. "Tree 30 feet. Fruit light green." *Schultes, Raffauf et Soejarto 24206.*

The Taiwano Indians call this tree *e-ree'-ka.* They consider the dried powdered bark mixed with fariña to be an effective vermifuge.

The collection *Schultes, Raffauf et Soejarto 24206* was alkaloid-negative with a Dragendorff reagent spot-test.

Haveteopsis flexilis *Planchon et Triana* in Ann. Sci. Nat., ser. 4, 14 (1860) 246.

COLOMBIA: Comisaria del Vaupés, Río Negro, Caño Ducuruapo (Igarapé Rana). "Bush. Flowers reddish." December 13–17, 1947. *Schultes et López 9350.*

In the upper Río Negro area, the crushed leaves of this bush are poulticed on the feet of those suffering from severely cracked skin. The treatment, over a period of several days, is said to soften the hardened skin and hasten the healing of the open areas.

Marila tomentosa *Poeppig et Endlicher*, Nov. Gen. et Sp. 3 (1840) 15.

COLOMBIA: Comisaria del Putumayo, Mocoa and vicinity. Alt. 750–850 m. December 3–7, 1942. *Schultes and Smith 3014.*

A warm decoction of the root of *Marila tomentosa* is considered to be an excellent treatment for dysentery among the Siona Indians of the region of Mocoa.

Oedematopus *aff.* **O. duidae** *Gleason* in Bull. Torr. Bot. Club 58 (1931) 406.

COLOMBIA: Comisaria del Vaupés, Río Macaya, Cerro Chiribiquete. "Bush extensive and scraggly, 8–10 feet tall. Trunk stout, latex weak, white. Fruit green. On dry, hot exposures." May 15–16, 1943. *Schultes 5462.*—Same locality and date. "Latex white. Scraggly bush. Fruit green." *Schultes 5480.*

Among the Karijona Indians of the uppermost Río Vaupés, this species has the reputation of being the strongest vermifuge available. Long trips are made to the Cerro Chiribiquete and elsewhere to obtain the dried leaves and bark.

Oedematopus obovatus *Spruce ex Planchon et Triana* in Ann. Sc. Nat., ser. 4, 14 (1860) 250.

COLOMBIA: Comisaria del Vaupés, Río Macaya, Cachivera del Diablo. May 1943. *Schultes 5515.*—Río Negro at confluence of Ríos Guainía and Casiquiare, Caño Ducuruapo (Igarapé Rana). December 13–17, 1947. *Schultes et López 9350.*

The leaves and bark of *Oedematopus obovatus* are valued among the natives of the upper Apaporis River basin as a strong vermifuge.

Oedematopus octandrus *(P. et E.) Planchon et Triana* in Ann. Sci. Nat., ser. 4, 14 (1860) 250.

COLOMBIA: Comisaria del Vaupés, Río Taraira, second rapids upstream. "Small tree. Flowers pink. Latex yellow." July 8–11, 1948. *Schultes et López 10201.*

The Makú Indians who frequently wander through the forests of the uppermost Río Taraira state that the flowers of this tree are employed as a contraceptive agent.

Quapoya peruviana *(P. et E.) O. Kuntze,* Rev. Gen. (1891) 61.

COLOMBIA: Comisaria del Amazonas, Trapécio Amazónico. "Flowers yellow." October 1945. *Schultes 6762.*

The Tikunas assert that the crushed roots of *Quapoya peruviana* were formerly employed as a minor fish poison.

Tovomita aff. **T. laurina** *Planchon et Triana* in Ann. Sci. Nat., ser. 4, 14 (1860) 282.

BRAZIL: Estado do Amazonas, Río Dimití, at base of Serra Dimití. May 12–19, 1948. *Schultes and López 10012.*

In the Colombian part of the uppermost Río Negro basin, a tea of the flowers of this species is believed to be helpful in controlling diarrhoea. A similar use is reported for *Tovomita brasiliensis* (Mart.) Walper in the Brazilian Amazonia.

Vismia angusta *Miquel* in Linnaea 18 (1844) 27.

COLOMBIA: Comisaria del Amazonas, Río Amazonas, vicinity of Leticia. August 29–September 12, 1966. *Schultes, Raffauf et Soejarto 24008.* Same locality. January 21, 1968. *G. Stout 16, 28.* Same locality. January 28–February 7, 1969. *Plowman, Lockwood, Kennedy et Schultes 2292.*—Same locality. March 6, 1975. *Zarucchi 1081.* Río Loretoyacú. January 28–February 7, 1969. *Plowman, Lockwood, Kennedy et Schultes 2372.*

This tree is called by the Spanish name *pichirina* and the Portuguese *lacre* in the Trapecio Amazonico of Colombia.

The use of the yellowish or orange-colored latex is common as a treatment for wounds and infected sores.

The resin of *Schultes, Raffauf et Soejarto 24008* was doubtfully positive for alkaloids with a Dragendorff reagent spot-test.

Vismia ferruginea *Humboldt, Bompland et Kunth* in Nov. Gen. et Sp. 5 (1821) 183.

BRAZIL: Estado do Amazonas, Manáos, Flores. "Flowers greenish white. Common bush in scrub growth. July 5-August 12, 1967. *Schultes 24594* (R. V. Alpha Helix Amazon Expedition 1967).
COLOMBIA: Comisaria del Putumayo, Río Putumayo above confluence with Río Mocoa. "A treelet 5 m. tall. Bark smooth. Sap colorless, turning deep yellow later. Fruits green. Crushed leaves give sweet smell. *Lacre.* August 6, 1964. *Olday et Hernández.*
PERU: Departamento de Loreto, Iquitos region. June 27, 1966. *Martin et Lau-Cam 1146.*

The resin of this tree is applied to sores and wounds in Brazil. In Peru, where the species is known as *pichirina de hoja menuda,* the "yellow-orange resin is applied like iodine to wounds and carachas."

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NOTES ON THE ETHNOMYCOLOGY OF BOSTON'S CHINATOWN

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Unlike the comparatively mycophobic North Americans, the Chinese have long used and appreciated a wide variety of fungi. Gathered from the wild or carefully cultivated, fungi provide the Chinese with tonics and condiments, foods and medicines. The following notes describe briefly several of the most interesting fungi purchased in Boston's Chinatown but widely available in Oriental markets throughout the United States.

Auricularia auricula Hooker

The best known edible phragmobasidiomycete is *Auricularia auricula* of the Auriculariaceae. This fungus, known commonly as the Black Fungus or Wood Ear, grows ubiquitously in northern temperate forests of both Europe and Asia usually in association with oak, elm, willow, poplar or chestnut trees. The fruiting bodies, which surface in late summer or early fall on top of rotting wood, are translucent and gelatinous, with a velvety grey, outer cortex while the inner concave surface bearing the hymenium is brown. The shape and fleshiness of the fungus is that of a club ear and hence in Europe it has the unfortunate vernacular name of Jew's Ear.

Although *Auricularia auricularia* is only occasionally eaten in Europe, in China it is the fungus most frequently sold as a vegetable. An active commerce exists throughout the country, and the center of cultivation is eastern Szechuan. There in the temperate mountains small oak trees are felled, cut into three foot sections and stacked at 90 degrees to each other to allow for proper aeration. To maximize productivity, the stacks are set in 30% light and on slopes of 10 to 30 degrees. The wood sets for a year or more, until it yellows and emits a sour odour of alcohol. Between April and June, the logs are artificially innoculated

with stored bottled mycelium through three to five holes in each log. The entire pile is then covered with straw and a waterproof tarp. The first fruiting bodies appear after 15 to 20 days; the fungus continues to produce basidiocarps for the entire summer, with production peaking in the hottest months of July and August. The harvested basidiocarps are sun dried, and packaged for distribution.

Restricted to the temperate forests of south China is a second and rarer edible species of Auricularia known as Mok Yee or the White Backed Auricularia *(Auricularia polytricha)* (Montague) Saccardo. Like the Black Fungus, it is cultivated, but on a far smaller scale. This fungus is extremely tough and is used only for making soups.

The two cultivated Auriculariass are similar in many respects. In both, the fructification is piliate, tough to rubbery and gelatinous when fresh, the abhymenium is densely pilose, and the basidiocarps are never concentrically ringed. Lowy (1971) distinguishes the two species on the following characters:

Auricularia auricula—abhymenial hairs 100 × 6 microns, hymenium brown at first, approaching black on drying, smooth to sulcate, medulla lacking.

Auricularia polytricha abhymenial hairs up to 450 × 6 microns hymenium drying purple to blackish, smooth to rugulose, medulla a single hyphal band up to 250 microns wide.

All edible Auriculariass must be carefully prepared. The dried fungus is placed in a bowl and boiling water is poured over it. In thirty minutes it will be succulent and edible. Several other *Auricularia* species are edible. *Auricularia fuscosuccinea* (Montague) Farl., a common fungus of the Amazon basin, is boiled for thirty minutes and eaten with hot sauce and cassava bread by the Bora Indians of the Peruvian Amazon. It is harvested from the rotting wood that accumulates in their fields.

Volvariella volvacea (Bull. ex Fr.) Singer

The Padi Straw Mushroom is the Chinese equivalent of the European field mushroom. A gill fungus of the Pluteaceae, *Volvariella volvacea* has a conical pileus 5 8 cm in diameter, which is darkened at the tip. The stipe lacks an annulus, is slender 8–12 cm long and 1.2 2.0 cm wide. When fresh, the fungus is white

with off white streaks on the pileus; the gills, white when young, mature to pink. Before sporogenesis, the entire mushroom is covered by a universal veil, the remnants of which are found at the base of the mature basidiocarp.

These mushrooms are cultivated on rice straw which is arranged in bundles weighing up to 4.5 pounds and about 3½ feet in length. The bundles consist of the leafless stems of rice and are soaked in water for twenty four hours before they are innoculated. The fungi are grown without light, and the beds are occasionally fertilized. The cultivation of straw mushrooms is common only in Kwantung Province of south China. Most of the straw mushrooms on the international market are produced in Taiwan.

Lentinus edodes (P. Henn.) Singer

In America, this is the best known Chinese mushroom. Though commonly known as the Black Fungus; it is properly referred to as Shiitake, which is the correct Japanese name. This is a temperate species growing on rotting wood. The pileus is brown but furrowed by white fissures and may be as much as 20 cm. in diameter. The stipe is brown and lacks an annulus. It is attached to the pileus excentrically and measures 3–4 cm. in length and 1 1.3 cm. in width. The gills are colourless and continue as ribs to the apex of the stipe.

Cultivation of the Shiitake mushroom is an ancient practice that began in Japan at least a thousand years ago. Today, in Fukien Province in China, the Shiitake is still semi-cultivated. A patch of oak woods on a second growth hillside will be felled. The elders invite all the neighbours and announce that the area is a mushroom reserve. No one is then allowed to disturbe the site. To remove wood for firewood would be considered stealing. The area may be watered and will occasionally be artificially innoculated. The mycellia penetrate the stems, and, within a year, the fruiting bodies will be produced.

Tremelles fuciformis Berk

This phragmobasidiomycete, known as Silver Ear, is a highly prized fungus eaten less as a vegetable than as a tonic. It is in greatest demand in south China and is so valuable that in pre-

revolution China only the top 15% of the population could afford to use it. Medicinally, it serves to stimulate the digestion and hence is administered to the sick and convalescent.

The Silver Ear is both gathered in the wild and cultivated. In nature, it grows in slightly warmer areas than the *Auricularia* fungi. It is commonly found on rotten wood in association with persimmon, wild fig, *Albizzia*, alder, *Dalbergia*, *Liquidambar*, peach, chestnut and maple mixed hardwood and deciduous forests. Almost all of the marketed Tremella are from cultivation. The innoculum is generated from spores in laboratories on a medium composed of 0.8 oz. agar, 6.5 oz. potato peels, 0.64 oz. glucose, 0.03 oz. calcium phosphate and one quart of water maintained at 68 to 80 degrees Fahrenheit, and a ph of 5.5. In a few days a white mycelium forms which can be transferred to the growing bed. The substrate is composed of 20 parts sawdust, 7.5 parts wheat bran, one part cane sugar and one part gypsum. The fruiting bodies appear in ten to fifteen days and are harvested and sun-dried.

Tremella is prepared usually as a decoction which can be taken either as a sweet or a salty tonic. The salty tonic is prepared with two gallons of water, a salted chicken, onions, Chinese dates (*Zizyphus jujuba* Mill.: Rhamnaceae) and a tablespoon of salt and one half ounce of revived Tremella. The sweet tonic, which is said to be especially good for the elderly, is made with 1.5 quarts of water, 3 tablespoons of sugar and one half ounce of revived Tremella. Both decoctions must boil for at least 90 minutes.

Cordyceps sinensis (Berk.) Saccardo

In the foothills of the eastern Himalayas of western China live the Yung, an alpine people of Tibetan stock. Their villages lie at about 7000 feet where barley, spring wheat and rhubarb are cultivated. Every spring, this tough people trek into the high mountains in search of their principal cash crop—Dong Chong Xia Cao or the Winter Worm Summer Herb—the darkened stroma of *Cordyceps sinensis*.

Cordyceps sinensis parasitises the larvae of *Hepialus armoricanus* Oberthür, a relatively rare Himalayan moth found only

above 11,000 feet. In the late spring the moth leaves its pupa and shortly lays eggs. In the short Himalayan season, the eggs soon hatch and a small larva develops. The spores of Cordyceps are scattered in the soil, and, as the worm burrows through the earth, it picks them up. The spores germinate and enter the worm's body cavity through the breathing pore. As the larvae grows, the hyphae multiply, and, by the end of the summer, all the worm organs have been thoroughly parasitised. The worm dies, and the hyphae consume everything inside the skin of the animal, and the body of the insect is functionally transformed into a sclerotium. The sclerotium settles on the base of the alpine grasses to overwinter. By September, it is buried by the deep Himalayan snow.

In late April, as the snow recedes, the spring meltwater saturates the dormant sclerotia of the Cordyceps, and as the dry mycelia absorb water, they enlarge and push up a vertical stroma. This stroma develops in late May, when only spotted thin patches of snow remain. By this time the Yung tribesmen have arrived at their alpine camps which are established specifically for the harvest of the Cordyceps. The experienced Yung spot the dark stroma against the backdrop of the receding snowfields. The Yung remain in their alpine camps for several weeks, drying the Cordyceps in the evenings over small fires. When the harvest is complete and before leaving the highlands, the Yung burn the alpine meadows to remove the excess grass cover so that the stroma are highly visible the following year. These fires remove only the superficial vegetation without damaging the underlying sod. The Hepialus larva are safely protected at the base of the grass blades at the surface of the soil. *Cordyceps sinensis* represents one of the few species of Ascomycetes that is semi-cultivated.

Cordyceps sinensis is rather rare and is much valued by the Yung; a pound of the fungus represents a fortune. The Yung sell their harvest to itinerant merchants who assemble a dozen or more individual sclerotia into small bundles and tie them with red thread. The red thread is significant, as red is the Chinese colour of good fortune and good omens. Interestingly, a bundle of Cordyceps collected by the French expedition to Hankow in

1872 and a bundle collected by Thaxter in 1932 (both on deposit at the Farlow Herbarium) are virtually identical to the bundles sold today in Boston's Chinatown. The handful of this fungus bought from the Yung by Chinese wholesale merchants make their way to all parts of China and to expatriot Chinese communities throughout the world.

Throughout China and especially in the tropical lowlands, *Cordyceps sinensis* is a much valued tonic and medicine. In Kwantung Province, it is served as a health food; elsewhere it is prescribed as a medicine. In Canton, it is considered indispensable as a tonic to prepare the body for the changing seasons. In early spring and in early winter, as the temperature of the seasons change, wealthy individuals buy a live chicken and two to four bundles of the fungus. The fungus and the chicken are boiled together and the broth is consumed. The fungal body itself is never eaten. Elsewhere in China, the fungus is dispensed pharmaceutically from all the medicinal shops as a treatment for anemia. For men, it is used popularly as an aphrodisiac. The head of an old duck is split open, and five stroma of *Cordyceps sinensis* are put inside before the head is tied up. One half of a cup of gin, and one quarter cup of soy sauce are poured over the head of the duck, which is then steamed for many hours, until it is tenderly cooked. The meat of the duck may be eaten and is believed to be a powerful aphrodisiac. If 0.5 to 1.0 oz. of Cordyceps is cooked in pork and the meat eaten, the individual will be blessed with frequent and pleasurable nocturnal emissions.

If antiquity of use is a reflection of value, then *Cordyceps sinensis* must be considered an efficacious aphrodisiac. The first written reference to its medicinal use appeared in 200 A.D. in the famous herbal of Pents'ao *Shen Nung Pents'ao Ching—The Classic Herbal of the Divine Plowman.* Yet, even today, the fungus may be bought in Boston. Quite remarkably, this humble ascomycete has been used continually for several thousands of years and may in fact represent one of the earliest and most primitive forms of plant husbandry.

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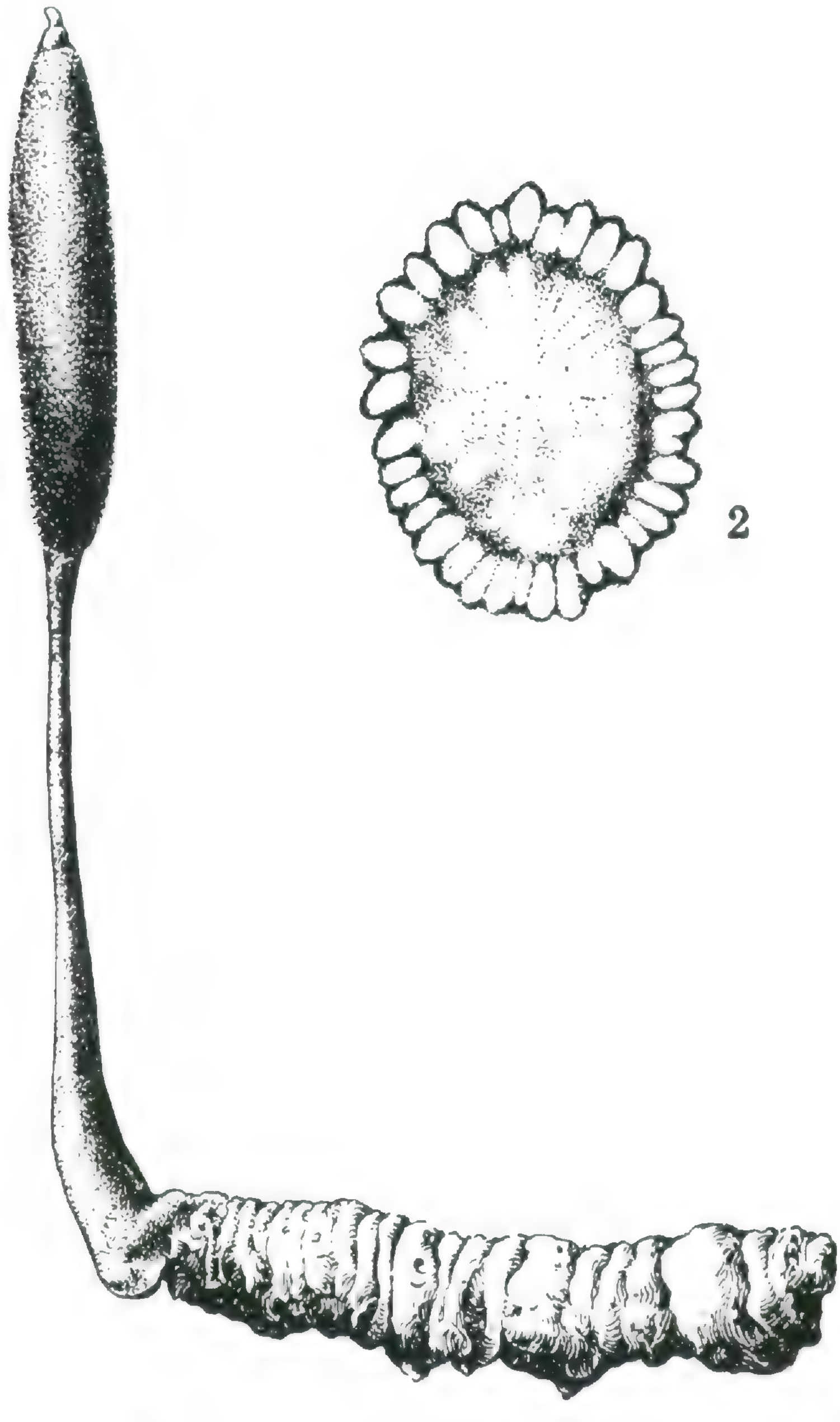

圖 397　冬虫夏草 Cordyceps sinensis (Berk.) Sacc.
1.植物全形　上部为菌座，下部为已蛰之幼虫　2.菌座之横切片，示子囊壳

Plate 7.　*Cordyceps sinensis* (Berk.) Saccardo

PLATE 8

Plate 8. Bundles of *Cordyceps sinensis* purchased in Boston's Chinatown.

BOTANICAL MUSEUM LEAFLETS
HARVARD UNIVERSITY

CAMBRIDGE, MASSACHUSETTS | SPRING 1983 | VOL. 29, NO. 2

GORDON WINSTON DILLON—1912-1982
AN APPRECIATION

RICHARD EVANS SCHULTES

The Botanical Museum, botany and especially orchidology lost a friend, a colleague and an innovator when, on August 22, 1982, Gordon Winston Dillon died at his home in East Orleans on Cape Cod, Massachusetts. He is survived by his wife, Mary, who devotedly helped him in his long struggle with illness, and his son David.

Gordon was born in Reading, Pennsylvania, on October 17, 1912. He was graduated from the Muhlenberg Township High School in 1934 and came to work as botanical illustrator at the Orchid Herbarium of Oakes Ames in the Botanical Museum in the same year. While his specialty was the orchid family, his versatility was such that he illustrated technical articles which demanded understanding of other plant families. In the academic year 1947-1948, Prof. Paul Mangelsdorf, Director of the Museum, appointed him as botanical illustrator in the Museum.

At that time, the then young American Orchid Society had its headquarters in the Orchid Herbarium in the Museum, and its *Bulletin* was edited in this location. When the editor Dr. Louis O. Williams was called to government work connected with the war in January 1943, Gordon assumed the editorship, a position which he carried out with exceptional distinction from 1943 to 1966 and from 1970 to 1973, when he retired from that position. In addition to his editorship, he fulfilled other functions as well in the Orchid Society. He was the Executive Secretary from 1950 to

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1976 and its Executive Director from 1976 to 1977. Partly as a result of his close association with the scientific work in the Ames Orchid Herbarium, he was ever cognizant of the importance of basic research in horticulture, which cognizance was instrumental in setting up in 1966 the American Orchid Society's Fund for Education and Research to foster botanical research, education and publication in orchidology. With deep interest in taxonomic and nomenclatorial matters, Gordon was innovative in setting up the International Orchid Commission on Classification, Nomenclature and Registration. He organized the First World Orchid Congress in 1954 and was active as programme chairman for all successive congresses through the seventh.

Perhaps no other fact more clearly illustrates the results of Gordon's organizational abilities than the incredible growth of the membership in the American Orchid Society under his stewardship, due in great part to his dedication and efforts.

Gordon's publications are many and spanned the field of orchidology from articles and the *Beginner's Handbook* for incipient orchidophiles to mature taxonomic papers. At the time of his death, he was hoping to write his *History of Orchids in the United States*. One of his most successful publications was the book *Orchids — A Golden Nature Guide* which he coauthored with F.S. Shuttleworth and H.S. Zim and which was superbly illustrated in colour by the late Mr. Elmer W. Smith, botanical artist to the Botanical Museum.

Upon his retirement, Gordon accepted an honourary appointment in the Museum as Archivist and initiated a study of the archives for the preparation of a history of the Botanical Museum. It was to be published in 1983 as part of the celebration of the 125th anniversary of the Museum's founding.

But Gordon was stricken with cancer shortly after he began this project and was able to research only the material covering the earliest years. His valiant struggle was, unfortunately, not successful in giving him the strength to carry out this labour of love which he had so long hoped to be able to do.

Gordon's passing has created a void which in many fields of activity will be hard to fill. His life, however, has left many individuals and institutions richer—the measure of a real life of dedication.

PLATE 9

GORDON WINSTON DILLON
1912–1982

BOTANICAL MUSEUM LEAFLETS
SPRING 1983

VOL. 29, NO. 2

THE BIOGEOGRAPHY OF PEYOTE IN SOUTH TEXAS

GEORGE R. MORGAN*

One of the most important economic plants within the subtropical flora of south Texas has been the Peyote cactus (*Lophophora Williamsii* (Lem.) Coulter. Due to the plant's hallucinogenic properties, Pre-Columbian tribes of south Texas, such as Coahuiltecan speaking peoples, gathered Peyote for their religious ceremonies. The plant has long been included in the Mexican pharmacopeia, having been used mainly for headaches and fevers. In the nineteenth century, tribes living outside the region adopted the plant for religious use and as a panacea medicine. Indians from Oklahoma and farther north pilgrimaged to south Texas to procure a supply of the psychotropic cactus. Professional Peyote traders, known as *Peyoteros* among Spanish speaking people, but called "Peyote dealers" among Indians, developed their practice probably in the later nineteenth century as suppliers of the cactus to Indians living outside the region.

This study focuses upon the biogeography of Peyote within its commercial range, with emphasis upon the dynamics of the plant's population changes in distribution and abundance due to man's intervention.

Peyote is native and endemic to North America. Most of the plant's geographic range occurs in northeastern and central Mexico; the Texas borderlands are the northern edge of the plant's range on the continent (fig. 1). Peyote is rare in west Texas; it is questionable that the plant was common there in historic times. The Mescalero Apache living in the area, or the Comanche travelling through the region on their way into northern Mexico, may have harvested the plant to near extinction. More probable, lower

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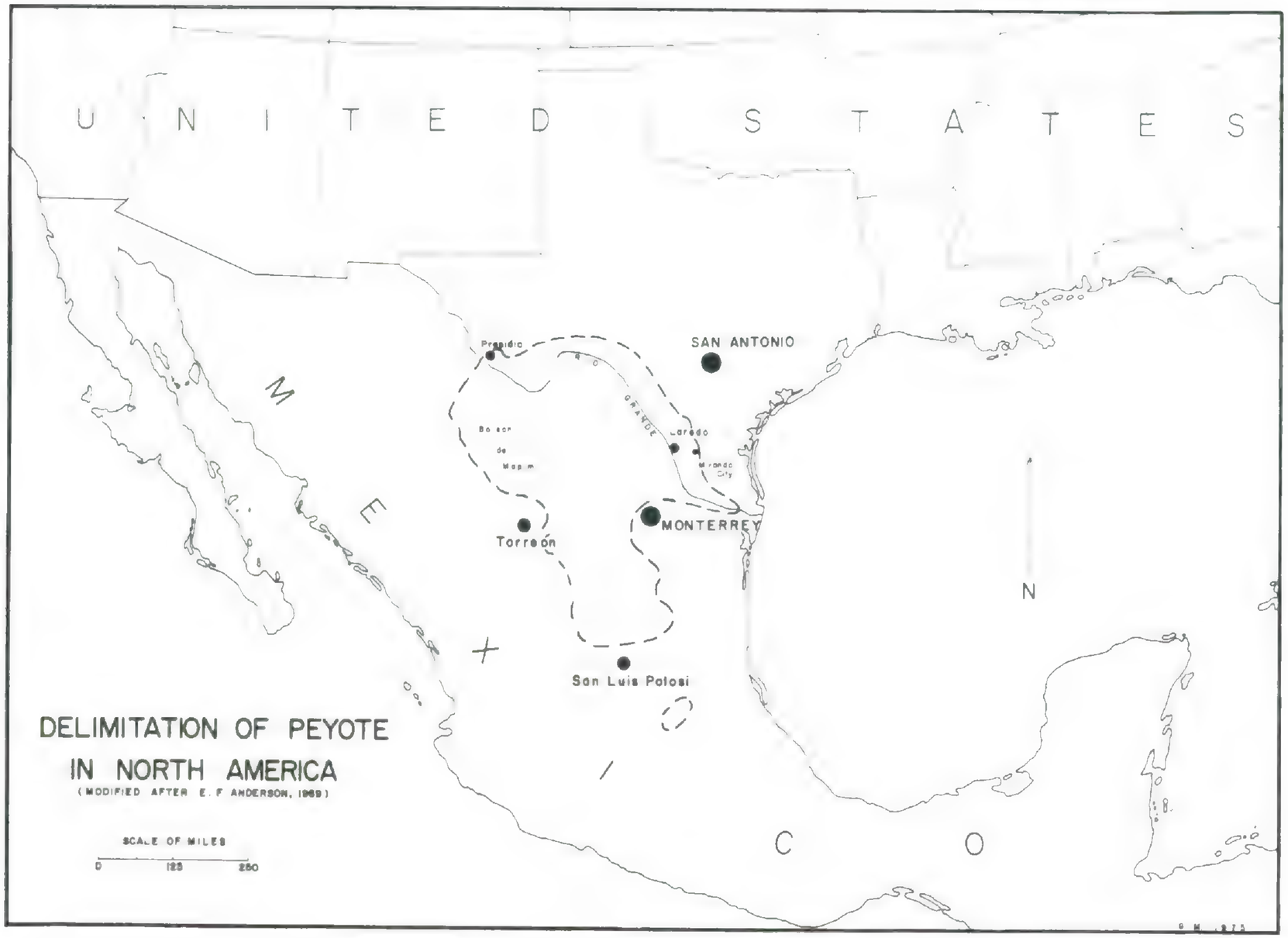

U N I T E D S T A T E S
SAN ANTONIO
Presidio
Rio Grande
Laredo
Monclova
Monterrey
Torreón
San Luis Potosi
N
DELIMITATION OF PEYOTE
IN NORTH AMERICA
(MODIFIED AFTER E. F ANDERSON, 1969)
SCALE OF MILES
0
125
250

winter temperatures in west Texas from those of southern Texas may account for the plant's rarity.

The climate of southern Texas is semiarid to subhumid subtropical, the northern optimum climate for Peyote abundance in North America. Climatic variables in south Texas which limit the abundance of the plant are drought and perhaps excess rainfall. Cyclical midsummer droughts combined with heat waves and high insolation rates scorch the vegetation; under such climatic stresses Peyote is one of the last plants to lose its chlorophyll pigmentation.

During dry periods many Peyote plant-crowns descend below the ground surface, thus reducing exposure to transpiration losses. The greater surface area of large, older plant-crowns, especially those that do not retreat below the surface, are more vulnerable to blistering, parching, and bleaching during a prolonged heat wave. The rainfall regime of south Texas is characterized by a double maximum: June rains followed by higher rainfall totals in September. Flooding sometimes accompanies the September rains which are associated with hurricanes. A *Peyotero* claimed that the root system of many Peyote rotted in the ground because of excessive rains and flooding during hurricane "Beulah" in 1967 (Dávila, 1974). Canadian "northers" frequent south Texas in the winter months, but the majority of these cold waves are considerably warmed when they reach the south Texas plains; their duration is brief. Occasionally, a "norther" does damage to the large subtropical plants but losses to plants of smaller stature, such as Peyote, are reportedly less.

Field investigation indicates that Peyote is more abundant on east and south-facing slopes. East-facing slopes receive more moisture from prevailing southeast Gulf winds. During early morning hours, low stratus clouds moisten the vegetation (fig. 2). South-facing slopes are more protected from cold waves in winter and warm up earlier in spring.

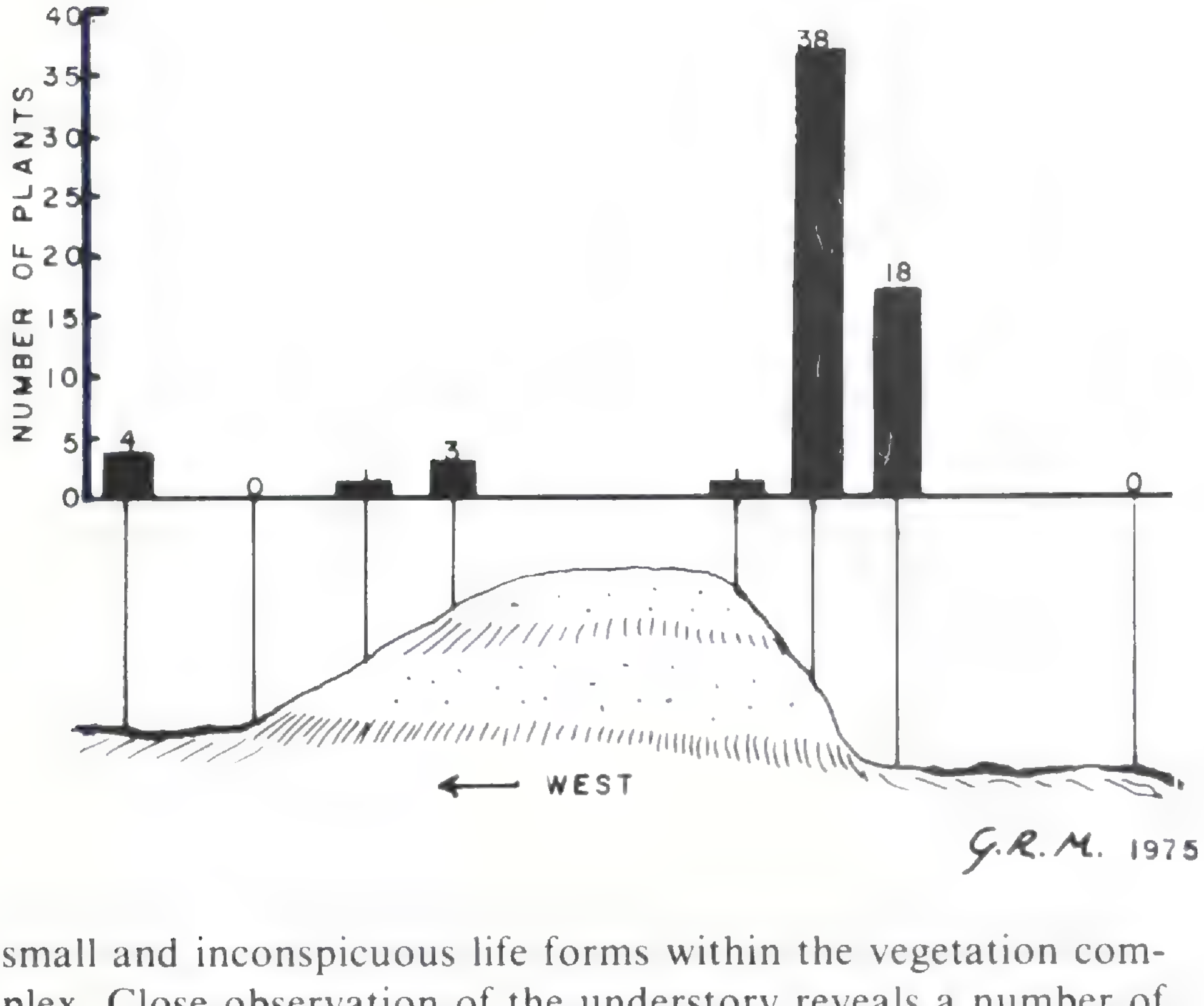
Peyote harvested by *Peyoteros* and Indians, today and in the historic past, occurs in four counties of south Texas: Starr, Jim Hogg, Webb, and Zapata. Within these four counties, the range of the plant with densities large enough to be commercially significant occurs along the western margins of the Bordas Escarp-

ment, the adjacent Aguilares Plain, and the Breaks of the Rio Grande (fig. 3). Peyote grows mainly along hill slopes and escarpments (fig. 4). *Peyoteros* and Indians seeking Peyote within the Aguilares Plain hunt the slopes of small hills (*lomitas*), especially if the overlying rocks are caliche. Harvesters also seek gravel and stony soils. These caliche and gravel-stony hills provide a stable environment for Peyote, an environment highly resistant to erosion, for caliche is porous, and gravel-stony surfaces intercept the impact of rain drops. Peyote grows in a variety of soil associations, such as Catarina-Copita, Copita, Jimenez-Quemado, Zapata (caliche soils), Maverick and Garceno, which all tend toward upland shallow to moderately deep, calcareous, clayey loams.

The thornbrush vegetation type dominates much of the south Texas landscape. The vegetation, having floral affinities with northern Mexico, has been named the "Tamaulipan Brushlands" (Correll, 1970). Lee R. Dice includes southern Texas in the "Tamaulipan" biotic province; he considers the region a "diluted form" (Dice, 1943). Indians refer to the area as the "Peyote gardens." The origin of this descriptive phrase is obscure. Perhaps the expression was more meaningful in the past when the plant was more abundant. Since the Peyote religion is a blend of Indian and Christian elements, possibly the expression "Peyote gardens" symbolizes the "Garden of Eden." Resident Spanish-Americans call the vegetation *chaparral;* they also refer to the vegetation as *monte*.

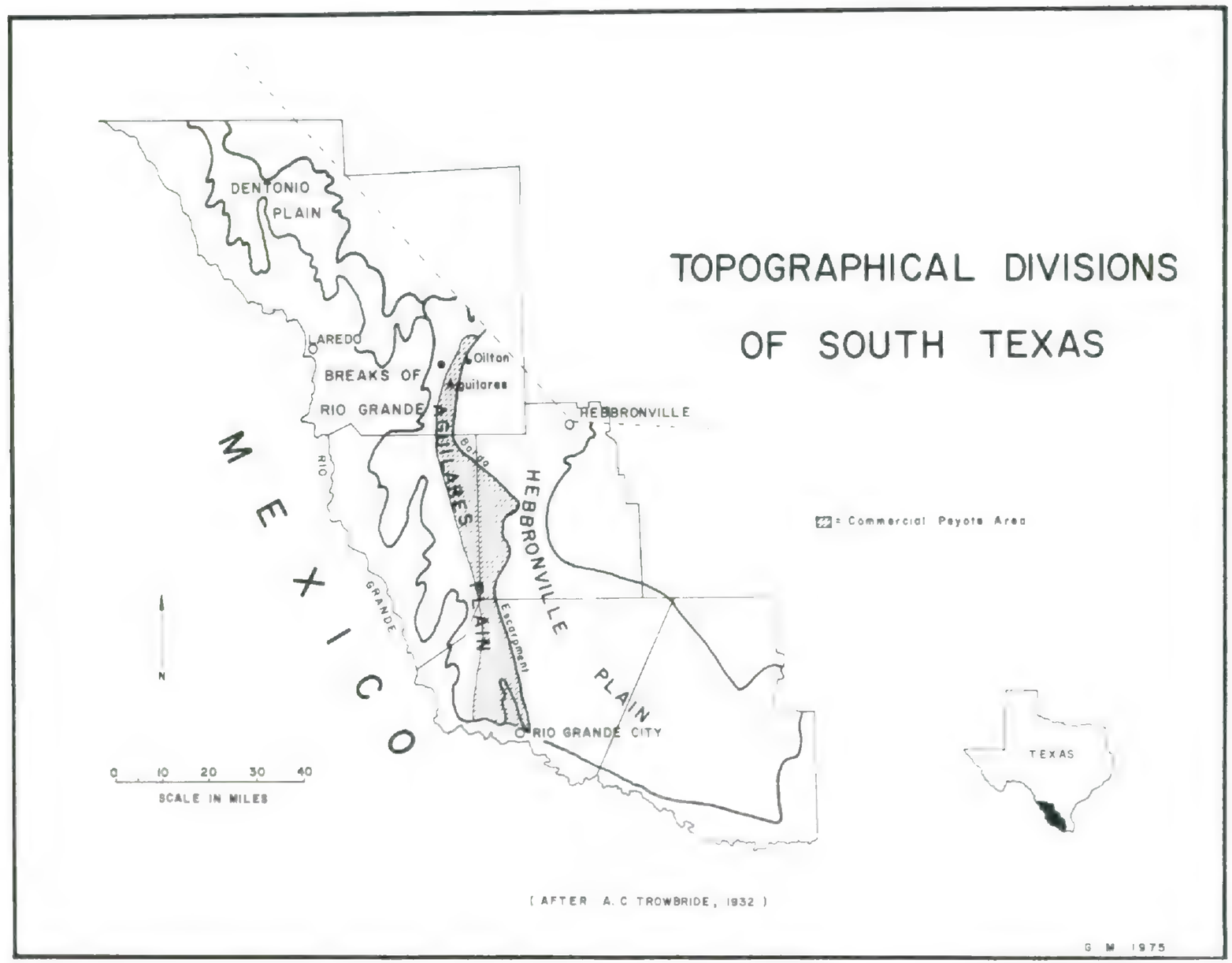
In some areas the vegetation is dominated structurally and floristically by black-brush acacia (*Acacia amentacea*), which Hispanos call *chaparro prieto* (black chaparral); *chaparral* in south Texas denotes vegetation with acacia, especially *chaparro prieto* (Clover, 1937). Other common shrubs in the Texas *chaparral* are: amargoso (*Castela texana*), granjeno (*Celtis pallida*), coyotillo (*Karwinskia Humboltiana*), cenizo (*Leucophyllum frutescens*), guayacan (*Porlieria angustifolia*), scrub mesquite (*Prosopis juliflora*), gobernadora (*Larrea tridentata*), and brazil (*Condalia obovata*).

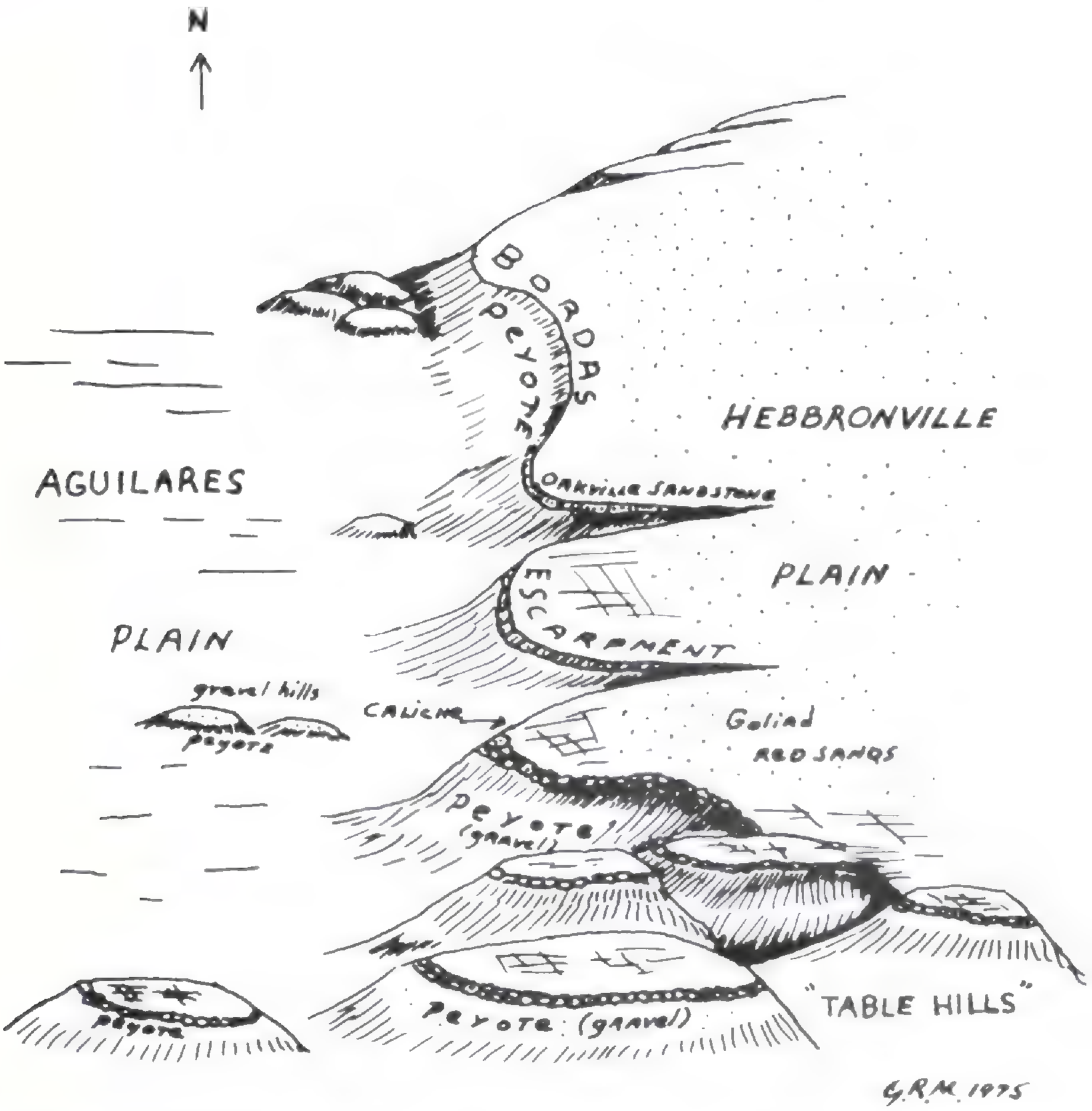
Outside of the large nopal (Prickly Pear, *Opuntia* spp.), and Tassajillo (*Opuntia leptocaulis*), most cacti, such as Peyote, are



small and inconspicuous life forms within the vegetation complex. Close observation of the understory reveals a number of different cacti. Peyote grows in association with a variety of plants; instead of seeking a particular indicator plant, *Peyoteros* look for a combination of landscape features in their search: caliche and stony-gravel slopes of small hills and escarpments, non-sandy soils, and a physiognomic life-form combination of shrubs and understory cacti are (Tassajillo and Pitaya cacti) often associated with Peyote.

Some *Peyoteros* have idiosyncratic means of hunting Peyote. One *Peyotero* claims that she is able to detect the plant through smell, a smell similar to the odor of "strong nicotine" (López, 1974). Another *Peyotero* said that he has insomnia from the fumes of the plants which he cuts; at night, with his eyes closed, he visualizes the location of plants which he finds the following day (Dávila, 1973). Indians consume the first plant encountered on the hunt; they believe they will then be able to find easily all the Peyote for their needs. Peyote leaders search for a particular Peyote plant having twelve or thirteen segments. This special


TOPOGRAPHICAL DIVISIONS
OF SOUTH TEXAS
DENTONIO PLAIN
LAREDO
BREAKS OF RIO GRANDE
Oilton
Aquilares
HEBBRONVILLE
MEXICO
RIO GRANDE
Bokilla
AGUILARES PLAIN
HEBBRONVILLE PLAIN
Escarpment
RIO GRANDE CITY
N
0 10 20 30 40
SCALE IN MILES
= Commercial Peyote Area
TEXAS
(AFTER A. C TROWBRIDE, 1932)
G M 1975



plant, sometimes referred to as "Father" or "Grandfather Peyote," becomes the highly revered "Peyote Chief," which is placed on the ceremonial moon altar as the visible intermediary Peyote between God and man.

A species of spineless cactus sometimes confused with Peyote is the "Star cactus" (*Echinocactus asterias*), an extremely rare plant in Texas, known to occur only in Starr County, bordering Mexico, where the plant is more common. Indians and *Peyoteros* harvest the "Star cactus," which they call "Star Peyote," as an ornamental; the plant's association with Peyote in a symbolic religious sense has resulted in this rare species to be almost close to extinction. One *Peyotero,* who sells "Star Peyote" as an ornamental to Indians, also had a potted "False Peyote" (*Ariocarpus fissuratus*) for sale. Navaho Peyotists are said to harvest two

plants for reasons other than specifically ceremonial: the root-bark of Guayacan for shampoo, and Drago (*Jatropha dioica*) sap for a dark red eye (Cárdenas, 1974). Indian pilgrims also seek religious mementos of stone, soil, and plant useful in their religious ceremony. A multitude of various colored stones are scattered across the landscape like jewelry. Marble-sized stones are used for bosses on the ceremonial drum; fragments of quartz are collected for musical gourds. Soil is taken home and shaped into a crescent altar. Though Peyote rarely occurs in red sandy soils ("Goliad sands"), a *Peyotero* noted that Cheyenne and Comanche Indians from Oklahoma obtained the red sand for their altar (Cárdenas, 1974). Wood of the Retama tree (*Parkinsonia aculeata*) has been sought for ceremonial drum sticks.

The shrub micro-habitat appears an opportune seed bed and protective environment during the early stages of Peyote's life cycle. Under the shrub canopy few other plants grow; shade and reduced wind movement reduce evaporation. The accumulation of soil and leaf litter under shrubs are favorable habitats for seed germination; many juvenile Peyote plants germinate within moist leaf duff. Peyote is much less abundant in more exposed habitats; on pathways between the shrub matrix the plant is trampled by deer and cattle, yet smaller plants embedded within pebbles escape trampling.

The thornbrush vegetation was formerly more restricted in areal extent. About 100 to 150 years ago, acacias and other thorny shrubs were largely confined to rocky, broken uplands, whereas deeper soils of level terrain supported a grassland to savanna vegetation type (Correll, 1970). Spanish settlement since the mid-eighteenth century altered the vegetation by overgrazing and frequent fires. The grazing of cattle, sheep, and goats, reduced the grass cover, and thus the combustible material; frequent fires also reduced the supply of fuel for future fires and encouraged the encroachment of brush (Cook, 1908). Carl O. Sauer suggested that the use of fire by Indians created a "cactus savanna" which increased the nopal, valued by Indians for its edible fruits (*tuna*), (Sauer, 1971).

Juvenile Peyote plants are normally unicephalous, but age and injury cause them to become polycephalous (Schultes, 1938).

Animals, especially cattle, injure the plants mainly by trampling. Apparently, no animal species depends on the Peyote plant as a major part of its diet. *Peyoteros* have noticed a variety of animals, such as rattlesnakes, javelinas, rats, mice, wild dogs, and Mexican eagles, eating limited amounts of the plant.

Indians and *Peyoteros* harvesting Peyote injure the plant by cutting and removing its chlorophyllous crown, thus intentionally stimulating its vegetative growth. The practice of cutting only plant tops and the foreknowledge that asexual clonal growth would result may be an ancient practice. A Cree Indian from Montana stated that for every plant he cuts "five more will grow back" (Denny, 1974). One *Peyotero* indicated that the growth of Peyote averages two inches in diameter within six months (Laurel, 1974). *Peyoteros* indicated that proper cutting—cutting only the larger plants, infrequent harvests, and rain—bring an abundance of growth. Measurements every six months for a period of two years indicated a substantial growth three times greater among cut plants than among uncut ones. Cut plants produced additional crowns at the end of each six-month period whereas uncut plants produced none.

Peyoteros refer to clonal clumps of Peyote as *planchas* (Spanish, plates). Until the 1940s, south Texas had many *planchas*, but today they are rare. Instead, *planchitas* (small *planchas*) are occasionally found. Harvesting accounts for the absence of *planchas* in south Texas today.

Harvesting alters the life form of Peyote plants; previously cut plants develop a thick, fibrous outer-layer at the root top. This fibrous, wood-like layer develops most where the plant had formerly been cut, and thus it may be a kind of scar tissue. Thicker layers of root fiber indicate more than one previous harvest. *Peyoteros* recognize this, since more effort is required to cut through the plant's fibrous layers. Furthermore, owing to previous cuts, sometimes new plant-crowns assume bizarre shapes.

In many areas of south Texas, the density of Peyote has decreased substantially within recent decades. One rancher from southern Starr County indicated that, in 1945, there were so many *planchas* on his land that it was like "walking on a mattress" (Muñoz, 1975). Today, although there is a considerable amount

of the plant on his land, it is little compared to the plant's former abundance. One *Peyotero* indicated that in 1972, he and five other workers harvested in Starr County about 19,000 Peyote plants in eight hours' time; in early June, 1975, they harvested only 200-300 from the same areas in the same amount of time (Olivárez, 1975).

Although *Peyoteros* and Indians agree that there is a decrease in Peyote abundance in areas available for harvesting, estimates vary considerably. Variations in appraisals are due to a number of factors. First, Peyote is a small plant in a big country. Small areas abundant in the plant, especially in thick brush country and some distance from access roads, likely escape notice. One such small area (approximately 200 square meters) was found in January, 1975, in northeastern Zapata County. From appearances, it is likely that it had never before been harvested. Within six months (January-June), over 10,000 Peyote plants had been harvested by a *Peyotero* who indicated that there was still more plants there (López, 1975). Second, there is secrecy about the locations of areas abundant in Peyote. Third, estimates are based on visible plants, and thus are often inaccurate.

Many areas alive with subterranean Peyote appear void of the plant, such as after a recent harvest or drought. Yet, in time, the perennial subterranean roots bud and produce more crowns under favorable environmental conditions, especially rain, so that areas appearing devoid of the plant may be viewed abundantly at a later time.

A Range Conservationist familiar with Starr County said: "Since the rains, all kinds of Peyote are coming up, hundreds of little ones in areas where I had never seen Peyote" (Willis, 1975). Finally, there is the possibility of new areas of Peyote from seed dispersal, but Indians and *Peyoteros* often harvest the plant when it flowers from June to September, thus reducing the total seed production of many populations in Texas. By harvesting flowering plants, harvesters may have arrested the geographic spread of the plant from seed, thus resulting in a greater dependence and a greater harvesting pressure on existing plants. Indian and *Peyotero* harvesters have become much more dependent on vegetative reproduction from existing populations.

The northern edge of the plant's range has receded southward since the 1930s as a result of harvesting. According to a rancher familiar with the area, the plant was formerly common near Freer, Texas, 42 miles north of its present abundance; harvesting has evidently caused the plant's rarity in the north (Walker, 1974).

Areas not available for harvesting have become more numerous within recent years. Many ranchers have locked their gates and forbidden any harvesting. Also, some areas have been transformed into sorghum fields or improved pastures. The landowner envisages many problems by allowing people on his land: spooked cattle, fire, and the possibility of someone being hurt or even killed in the snake-infested brush (Fulbright, 1974). Locked gates have increased tensions between landowners and harvesters; trespassing has become a problem. The keys to the few fields where harvesting is allowed are held by *Peyoteros*, who lease the land. Brush control has been an increasingly common activity in the south Texas landscape since the 1930s. Accelerated within recent years because of Government aid, land is cleared for improved pastures. Brush cleared by "chaining" or "chopping" is said to revert to brush of previous density and height within five to ten years (Davis, 1965). In recent years, the shift toward "root plowing," followed by re-seeding of native and introduced grasses, has more effectively altered the habitat, and has kept back brush re-invasion for a longer period of time. Peyote is least disturbed by "chopping" since most of the plant lives underground. "Chaining" in one direction minimizes damage to the plant, but "chaining" back across the field tends to greatly reduce it from the field (Cavazos, 1974). "Root plowing" is most destructive to Peyote, yet even after an area has been "root plowed," some underground roots continue to sprout new crowns. The only topographic areas of Peyote escaping the root plow are gravel hills, which are fortunately areas where the plants tend to be concentrated. Gravel hills may eventually be the only areas where the plant will remain concentrated. Within the last five years, the U.S. Soil Conservation Service in Texas refused to cost share with the rancher in brush removal of those areas where the Peyote plant occurred; this change in policy was due to the plant being considered an endangered species in Texas by the "Texas Organi-

zation of Endangered Species" (TOES). The effectiveness of this new policy would depend upon a number of factors, including the care taken by Range Conservationists.

The increased frequency of improper harvesting within the last few years by Indians and teenage "cutters" hired by *Peyoteros* is said by many people concerned with the plant to be a major cause of the plant's reduction. Improper harvesting would include not only derooting and cutting deep or too shallow, but harvesting flowering and immature plants. *Peyoteros* in Starr County traditionally sold Peyote by the "sack," a practice which encouraged deep cutting. Since 1977, the Texas Department of Public Safety (Narcotics Division) required Peyote traders (all of whom must be registered) to specify in an issued sales book the number of plants sold. This regulation officially ended sales by the "sack," and thus reduced deep cutting and de-rooting of the plant. But sales by the number encouraged cutting immature plants; harvesting pressures on fewer areas of harvest have resulted in most of the plants in the field being immature. Most Indians use improper tools for harvesting, especially long shovels, which tend to mutilate the plant. The ideal tool specifically designed for Peyote cutting, the one traditionally used by *Peyoteros*, is a "cutter," which is like a sharp, straight-edged hoe with a handle approximately two feet long. Requiring only slight pressure on the handle of this remarkable tool, severed crowns can be retrieved with ease from the dense thorn brush.

There has been a large increase in the number of Indians coming to Texas since 1968; most have been from the Navaho tribe. Although some Navaho used the plant in the 1930s, by the late 1960s the Navaho became the major consumers of Peyote in North America. Larry Etsity, Vice-President of the Native American Church of Navaholand, estimated that, as of 1975, there were about 70,000 Navaho following the "Peyote Way" (Etsity, 1975); that is well over half the Navaho using the plant. Peyote sales of 1972 73 indicate that the Navaho of Arizona alone (many Navaho live in New Mexico and California) purchased over a third (38 per cent) of the total recorded sales that year. The following year (1973- 74), the Navaho purchased over half (53 per cent) the Peyote recorded sold. Records of 1973-74 indicated that

the total Navaho nation purchased four of every five plants sold.

The large and sudden increase in Peyote consumers, and concomitantly fewer areas available to harvest, have accelerated the price of the plant sold by *Peyoteros*. In 1966, Indians paid $15.00 per 1,000 dry plants (the dried crowns known as "Peyote buttons" in the trade); by 1983 the price has increased to $80.00 per 1,000 dried crowns. *Peyoteros* indicate that the price increases are due to higher operating costs, such as gasoline prices, and higher lease payments. Delays and shortages of mail-order dry Peyote has perhaps been a greater problem to Indians than price increases; a major reason for the unavailability of dry Peyote is that wealthier Indians and better organized groups buy large amounts ("loads") of green Peyote in Texas (green Peyote costs $10.00 less per 1,000 plants); much of the harvest is bought almost as soon as it is cut.

In sum, the biogeography of Peyote in south Texas has been greatly altered due to man, namely the removal of brush for land-use change, and the shrinking of the plant's range and diminution of its density due to harvesting pressures from reduced acreages and increased consumer demand. Basically, those areas of Peyote most likely to escape damage and loss are areas least accessible to harvesters and too poor to warrant brush clearance.

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VOL. 29, NO. 2

THE ETHNOBOTANY OF THE DRESDEN CODEX WITH ESPECIAL REFERENCE TO THE NARCOTIC NYMPHAEA AMPLA

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ABSTRACT

An analysis of the glyphs and pictorial evidence in the Dresden Codex of the Maya provides an insight into the diversity of plants employed by these ancient people. While maize is the preeminent plant, being the essential food of the Maya, this codex reveals a host of plants of medicinal value. There is a disproportionately large representation of narcotic plants, if one assumes that inclusion is based merely upon nutritive, decorative or emblematic value. The white water lily of that region, *Nymphaea ampla* DC., is especially frequent in depictions. This inclusion is attributed to its narcotic properties (aporphine and quinolizidine alkaloids). The presentation of this codex by Thompson (1972) has served as a working model with respect to organization and visual sources. Interpretations herein are not necessarily in accord with those of Thompson.

Three authentic Maya Codices survive to this day: the Dresden, the Madrid, and the Paris, each name being indicative of the city in which they are to be found. In addition to these codices, we have the Grolier Codex of unknown provenance first seen publicly in 1971 and preserved in a private collection in New York. Several scholars had expressed serious doubts concerning the authenticity of the Grolier Codex based upon pictorial-ritual aspects of the document as well as its physical properties, but a radiocarbon analysis has produced a date of 1230 with a latitude of 130 years' error.

The Dresden Codex is of a ritualistic, divinatory and calendric nature. The astronomy of Venus, while accurate, was used as a means of predicting the fate of mankind. The glyphs and illustrations are figured on a screen of continuing folded leaves, each about 22 cm high and 11 cm wide; the whole manuscript is 6.70

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meters long. The paper was made by pounding the fiber from the inner bark (the bast) of *Ficus continifolia* HBK., native to Yucatán, which is probably *Tlilamatl*, or black fig. The glyphs and illustrations were executed only after the fiber had been moulded into a paper and both surfaces sized with lime. All surviving manuscripts mentioned are on this sized *Ficus* paper. In 1520, Peter Martyr wrote of the process by which the codices were executed using the inner bark of a plant which he believed that they called *philyra;* conjoined leaves were accomplished with fibers and what Martyr asserted to be bitumen. Diego de Landa, in 1579 (*fide* Pérez Martínez), asserted that some of the nobles were acquainted with the fields of knowledge found in these codices, but that they did not display this knowledge. Likewise, Antonio de Ciudad Real stated in 1873 that "only the priests of the idols, called *ah kins* in that language, and an occasional noble understood these figures and letters. Afterwards, some of our friars understood them, knew how to read them, and even wrote them." In all of these books, it would seem that prophecy and history were integrally bound together, the reason being found in the belief that each *katun*, or twenty years of 360 days each, would recapitulate a previous *katun* that ended in the same number. Prophecies for a given *tun*, or 360 day year, would begin at the onset of that year and would relate to a previous sequence. Such sequences would necessarily include disease and pestilence and the shamanic cure by power. There is no evidence for the recording of mundane affairs in such important codices. Ritual and history were repeated in poetic forms that probably constituted litanies or musical chants and incantations.

The Maya probably believed, as the Mixtecas, that their ancestry originated in the roots of the ceiba tree, *Ceiba acuminata* (S. Wats.) Rose the seeds of which are enmeshed in a white cottony fiber that is in the sky like clouds. Families were seen as fruits on such a tree, according to Ximénez (1929–1931). Similar belief systems are to be found throughout the world, a notable example being that of the Eboka of equatorial Africa who venerate *Tabernanthe Iboga* Baill., a plant containing the spirits of the deceased and from which all of their people originated (Fernandez in Furst [ed.] 1972).

The tree *Theobroma Cacao* L. among the Maya was called *caca* and was usually indicated by the visual presentation of the prolate fruits of the plant. The seeds of this plant were highly valued and served the Maya as a currency. When made into a beverage, after being ground into a powder, theobromine in the seed was released and served as a mild stimulant. The beverage was undoubtedly bitter, as the innovation of adding sugar came much later, after the ancient Maya civilization had collapsed.

Apart from this brief commentary on two trees of some consequence with respect to Maya ancestry and currency, it would be desirable to peruse the entire Codex using the system established by Förstemann in his 1892 edition of the Dresden Codex as it has been used by scholars ever since the appearance of this edition, even though subsequent commentaries and editions have appeared. For those students of Maya scholarship wishing to locate a particular series of glyphs, the Förstemann system divides each page into three vertical sections (rarely four) that are conspicuous in the original manuscript, and these are lettered from top to bottom as a, b, c and rarely d. Where these *t'ols* are absent, the pages contain vertical columns; the width of each of these is lettered from left to right in alphabetical sequence. Captions for units of pages such as "almanac" or "lunar table", etc., have been retained, and each *t'ol* is numbered sequentially under such a caption. For example, "Almanac 6" has only two *t'ols*, numbered T1 and T2. In this commentary, I shall omit any *t'ols* that do not contain glyphs or images that relate to plants. It should be noted that the first two Almanacs of the Dresden Codex are in such poor condition that commentary cannot be made on such motifs or glyphs, if indeed they may have existed. Gl is used for glyph. Where lunar tables interrupt the sequence of Almanacs, they have been integrated into the sequence.

MISCELLANEOUS ALMANACS

Almanac 3 (p. 2a)

T2. Seated maize god with his glyph above
- Gl. 1. abundance of maize
- Gl. 4. maize god

Almanac 5 (p. 2c)

T1. Maize god inserts needle with thread into frame
Gl. 4. abundance of maize

Almanac 6 (p. 2d)

T1. Seated moon goddess. Her outstretched hand holds what appears to be a stylized water lily (note the petiolate glyph opposite the flower). This is ritual divination (Thompson, 1972). I do not concur with Thompson's suggestion that this is the working of tortoise shell. The flower-like motif (Rands, 1953) suggests the water lily, *Nymphaea ampla* DC., that was used as a narcotic in ritual divination (Emboden, 1979).

T2. While no botanical motif is suggested here, it is appropriate to mention that the death god represented is frequently associated with the water lily as is the jaguar and an aqueous underworld. The depiction may relate to the prognostication of the moon goddess, Ixchel, in the process of divination.

Almanac 7 (p. 3a)

T1. The body of a sacrificial victim has become part of a stylized tree that is an amalgamation of botanical motifs. Hybridization of plant motifs was common to the Maya (Emboden, 1979). From the victim's gaping abdomen there arises a "world directional tree" common to temple reliefs and found in the Codex Borgia (pp. 49–52). In the crotch of the tree is a cormorant; Thompson (1972) believes it to be a vulture, but the figuring of the body and beak suggest a cormorant. This bird is seen in a stylized underwater tree in Coe (1973, polychrome vase 20 and others).

Gl. 1. The jaguar paw. This may be associated with the figure that has become known as the jaguar of the water lily, for the flower is often seen on his head as he dominates the underworld.

T2. The maize god holds a bowl of comestibles.
Gl. 1. maize
Gl. 2. maize god
Gl. 3. abundance of maize
Commentary: In the bulbous mass that constitutes the part of the tree under the victim's body, one may trace elaborate roots at the base. Upon these, at either side, are floral elements. That to the right suggests one of the water lily motifs delineated by Rands (1953) and may be a clue to the ritual nature of the sacrifice.

Almanac 8 (pp. 4a–10a)

T1. (p. 4a) There is depicted a rare deity found nowhere else in the Dresden Codex. Tozzer and Allen (1910: p. 310) suggested that it was a tree toad. It would appear to be a toad of some sort holding a snake. More important to this discussion is the water lily emblem on the headdress of the figure. As pointed out by Emboden (1981), this toad-water lily association is probably related to the potential psychotropic properties of bufotenine from the toad and nupharine and aporphine from the water lily. It is part of a divinatory almanac (Thompson, 1973), and thus such an interpretation lends greater meaning.

T2. The absence of a botanical motif still requires comment. The god is here identified as God N. It was this figure that, in the legend of the Hero Twins, was assassinated by one of them. He is often seen in his shell which usually has a water lily attached to the back of it (Coe, 1973, image 70). This figure reinforces the assertions made in T1 (above).

T8. Gl. 6. abundance of maize

T9. A death god wearing a pendant water lily in his complex head dress. The presence of the water lily (*Nymphaea ampla*) may be used in the emblematic sense of power.

T14. (p. 8a) The jaguar water lily is depicted with the flower emerging from the fore part of his head. This is the only occasion that Thompson found in his 1975 analysis of the Dresden Codex to identify the water lily. The figuring is no clearer than in other portrayals, so we must conclude that the iconography was deciphered by way of the jaguar association. In this connection, the reader is referred to the stimulating presentation by Coe (1973).

Gl. 5. abundance of maize

T15. (p. 8c) The figure depicted to the left in this representation bears a reflexed water lily on his head dress. The significance is not apparent to me, nor has it been discussed by those who have worked on the Codex.

T18. The maize god is depicted and glyphs 3 and 4, respectively deal with the maize god and the abundance of maize.

T19. (p. 10a) Barthel (1955) indicated that the affixes stand for a magical phrase "*che yetel tunich.*" *Yetel* was one of several forms of tobacco used by the Maya (Roys, 1933: footnote p. 99). For an extended account of the use of narcotic tobaccos in ritual intoxication among the Maya see the account of Furst (1976). The associated glyphs translated by Thompson (1966) as "affliction of strife" would seem to bear upon this ritual intoxicant that was smoked, drunk, and possibly introduced as part of an enema (Furst, 1976).

Almanac 9 (pp. 10a–12a) Divinatory

T2. (p. 11a) The *Muan* bird wears a maize headdress.

T5. (p. 12a) The maize god holds a vessel containing pods of *Theobroma Cacao.* These are identified in Gl. 1.

Gl. 2. Maize god

Gl. 3. Abundance of maize

Almanac 10 (p. 12a) The almanac is designed to serve twice over; see Almanac 9 and Almanac 11.

T1. (p. 12a) God K holds a dish of cacao seeds identified as such by glyph one.

Almanac 11 (p. 13a) Divinatory

T1. (p. 13a) The God Chac (God B of Zimmermann, 1956) holds a bowl of *Theobroma cacao* and the seeds. The head dress bears three flowers that I idéntify as *Nymphaea ampla* emerging from two cup-like structures bearing cross hatching. The latter are common representations of the leaves of *Nymphaea*. This flower is particularly suited to Chac for reason of his identification with all watery elements.

T2. (p. 13a) Death god holds a bowl of cacao fruits with one seeds visible. The seeds of the plant *Theobroma Cacao* were used sacrifically by sprinkling them with blood. When Sahagún (1956) described the cacao plant in the Florentine Codex he refered to the green fruit stating: "When much is consumed, especially if it is green . . . it makes the heart of people evil (Book 11, p. 119). We would have trouble ascribing this behavior to the xanthine alkaloids in the seeds, but it is possible that the fruit was fermented into an inebriating beverage that may have been further fortified. The frontal head dress of this figure is a bilabiate flower suggesting *Salvia divinorum* Epl. and Jat., a hallucinogenic member of the mint family cultivated in riparian habitats to-day by the Mazatecs and possibly corresponding to *pipilzinzintli* of the ancient Nahuas. One may argue that this is not the present distribution of the plant, but the same may be said of peyote, tobacco and a host of other sacred plants. This suggestion is only tentative, but the bilabiate flower in a conspicuous calyx on this death figure argues strongly for such an interpretation. Likewise, the water lily, *Nymphaea ampla* on the back side of the head dress reinforces the contention that we are dealing with a multiplicity of narcotic plant elements associated with a single figure in a divinatory almanac.

Almanac 12 (pp. 14a–15a)

T1. (p. 14a) The Maize god with a maize head dress points a finger.

Almanac 13 (p. 15a) See Almanac 23 for similar motifs. T1 God D dives earthwards as though in water. From one foot there emerge two cacao pods and two more are attached to an elbow. Thompson (1972) associates this figure with the diving bee god. It is worthy of note that from his back a peduncle and bud of the hallucinogenic *Nymphaea ampla* ascends. Thompson takes this to be *Theobroma Cacao* again, but it is unlikely, as cacao has no peduncle but is sessile and attached to the branches of the cacao tree. It is consistently portrayed in this manner.

T2. A diving death god has cordate leaved vegetation replacing his right foot suggesting the leaves of both *Turbina corymbosa* (L.) Raf. and *Ipomoea violacea* L. Both plants bear seeds containing amides of lysergic acid and are hallucinogenic. The relationship of this to the creation story is recapitulated in Almanac 23 as it is presented here. The diving god and *Nymphaea* will appear in a later paper.

Almanac 15 (pp. 5b–6b) Divinatory

T1. According to Thompson (1972) the presentation is of the *chacah* or gumbolimbo tree (*Bursera Simaruba* L.) which is being drilled to produce fire.

T2. Death god with the same drill and wood.

T3. God D with the same fire drill and wood.

T4. God Q with the same fire drill and wood.

Almanac 18 (p. 9b) Divinatory

T1. The maize god squats before God D. Emerging from before the forehead of the God D is a pedicellate water lily.

Gl. 5. The maize god.

Gl. 1. Abundance of maize.

Almanac 19 (p. 10b) Divination involving *Theobroma*

T1. A Chac is seated holding a pot of *Theobroma Cacao* seeds.
Gl. 2. Cacao

T2. (p. 10c) God Q, associated with war and sacrifices holds a bowl of *Theobroma Cacao* fruit and seed probably indicating the blood sacrifice to be made over the seeds.

Almanac 20 (pp. 10b–11b) Divinatory

T1. Glyphs indicate the giving of cacao beans. There is no accompanying picture.

T2. The sun god holds a vessel of cacao seed; this may also be seen in Almanacs 10 and 19. Glyphs again indicate the giving of cacao beans.

T3. The Maize god is seen with the same vessel of cacao beans and a double head dress of *Nymphaea ampla*. The fish in the head dress and the fish touching upon the frontal water lily suggest aqueous elements and the murals at Bonompak. Glyphs read "he gives cacao beans; 2 "abundance of maize; 3 maize god."

T4. Glyphs repeat the giving of cacao beans. This has now started to form a kind of litany by way of repetition.

T5. The repetition of giving cacao beans. The frequency of this should be no more curious to us than the *kyrie eleison* repeated in western masses.

Almanac 21 (p. 12b) Divinatory

T1. (p. 12b) A female death goddess with black spots wears a water lily to the front and rear of her head dress with a rhizome-like appendage between the flowers (note root-like extensions on the rhizome).

T2. Goddess H wears a nose rod that terminates in a flower that is unidentified. It should be pointed out that the size of a flower as it is portrayed in any codex has little to do with its actual size but relates to its importance in what is being portrayed. The relationship to one of the

sensory modes suggests that perhaps the flower is of ritual significance.

Almanac 22 (pp. 13b–14b) Divinatory

T1. (p. 13b) A squatting death god with the body of an insect hold a maize glyph in his left hand. The frontal floral motif is that seen in Almanac 10 (T2, 13a) and identified as the hallucinogenic labiate *Salvia divinorum*. It should be noted that the insects that feed on these psychotropic plants carry the chemicals in their bodies. For this reason some beetles and their larvae have been used to induce altered states of consciousness.
Gl. 2. Sprouting maize

T2. Maize god with maize headdress and maize glyph in his right hand sits with his legs crossed. He wears the maize head dress and in the beak of the bird as two cacao pods.
Gl. 1. & 2. He takes care of new maize
Gl. 3. Maize god

T3. God C is seated with a maize glyph in his right hand. In his headdress, slanting backward, is the water lily with quetzal feathers inserted in it.
Gl. 1. & 2. Are repeats of T2

T4. A seated Bacab holds the maize glyph in his right hand.
Gl. 2. Ripening maize

T5. Seated God Q with maize glyph in his left hand.
Gl. 1. & 2. Are repeats of T4

T6. Seated God D with a maize glyph in his right hand. Thompson (1972) interprets the complex head dress as that of a centipede. I would suggest that it is a rhizome-like extension terminating in a flower in front. The back of the head dress is a giant water lily with quetzal feathers inserted.
Gl. 1. & 2. Repeat T4
Gl. 4. Phonetic equivalent of maize ripening

Almanac 23 (pp. 15b–16b) Divinatory

T1. A complicated presentation of the god Chac diving with cacao pods on his left heel. In his left hand is a maize glyph with cacao pods beneath it and a sprouting plant with cordate leaves above. This relates to Almanac 13 and according to Thompson (1972) may relate to the creation story in Chilam Balam of Chumayel in which there are references to the descent of flowers and gods bearing vegetation. The plant motif suggests to Thompson a sprouting tree trunk. I do not see it as such; rather, the leaves and vining aspect suggest the sacred *Ipomoea violacea* (also *Turbina corymbosa*) the seeds of which have amides of lysergic acid and were widely used in the area of Mesoamerica for ritual intoxication and resulting divination. Such an explanation is in keeping with the divinatory nature of the codex as well as the morphology of the plant presented. This idea had occured to Thompson (1972), for in Almanac 11 (p. 13a) he first believed that the pointed, obovate fruits in the bowl might have been *ololiuhqui*. He was convinced to the contrary by Caso who pointed out the associated round beans (the seed of *ololiuhqui* is pointed). Thus my suggestion at this point is not beyond the belief system of Thompson with respect to these people.

Gl. 1. The glyph *lah* suggests bee keeping and/or the diving bee god (questionable).

T2. The diving death god repeats T1 and has cacao pods on the left elbow and shoulder.

Gl. 1. & 2. Repeat of T1.

T3. A youthful goddess with a coiled serpent in her hair sits holding a bowl with stylized flowers emerging from the surface. This is much like some of the portrayals of the *balché* ceremonial vessels in the Codex Vindobonensis which show, in color, three white flowers on the surface. I have suggested (Emboden, 1979) that the flowers

are *Nymphaea ampla* even though they are not in proportion to the size of the vessel. We know that *balché* was a drink fortified with several other plants, and that *N. ampla* is implicated. This would permit the ritual beverage to transcend the ordinary inebriated state that one might expect from a mere fermented alcoholic beverage. The associated glyphs are indecipherable, but Thompson's suggestion that they are associated with T1 and therefore also with Almanac 13 implies the bee which produces honey. It was honey that was fermented to produce the mead-like *balché*. Honeycombs, hives, and *N. ampla* are seen together in the Codex Vindobonensis Mexicanus. It is suggested by Thompson that this is possibly Xcolel (Our Mistress), but she may well be one of the shamanic caste of women who played an important role in Maya shamanic stratification and were most probably the preparators of *balché*.

The serpent in the hair of Xcolel may be emblematic of the cordate-leaved plant and I have suggested as *Ipomoea violacea* in T1 and T2. The Aztecs knew the morning glory as *coatl-xoxuhqui* or "green snake plant," because of its vining habit. This may imply one more additive to the *balché*. Glyph 3 indicates white God H who may be a prophet or priest of either sex. There can be little doubt that we are dealing with shamanic divination in this picture and the two previous ones.

T4. (p. 16b) The God M sits holding a bone as a sort of scepter. From his turban there emerge two flowers. The attendant glyphs in no way clarify the nature or function of these.

Almanac 24 (pp. 4c–5c) Divinatory

Commentary: Kinich Ahau, the sun god, and Itzam Na, God D, both figure in this almanac and this has led Thompson (1972) to suggest that the almanac deals with divining the outcome of disease.

T3. God H is seated on a dias and has in his head dress a water lily flower on a peduncle.

Almanac 25 (pp. 5c–6c) Divinatory

T1. (p. 5c) God D is seated and holds a small cup of *balché*. The usual preparation of this ritual beverage seems to have been fermentation of honey to which had been added the bark of the tree *Lonchocarpus yucatenensis Pitt. (L. longistylus Pitt.)*. Several other plant additives have been suggested by this author (Emboden, 1979).

Gl. 1. abundance of maize

T2. A seated death god holds what Thompson (1972) has suggested is a seed bag. I cannot add to this.

Gl. 1. repeat T1

T3. (p. 6c) God C walks carrying before him what appears to be an incense burner. The use of copal in ritual purification was a common practice among the Maya and their successors. While copal may be derived from several plants of that area, the investigations have demonstrated the plant to be *Icica Copal* Schlecht. & Cham., a small tree of the family Burseraceae. Upon wounding, the plant releases resins that harden and may then be heated to produce clouds of smoke. In the book of Chilam Balam it was called "brains of the sky."

Gl. 1. Repeat of T1 subsequent glyphs portend good

T4. God Q walks carrying the copal censer. Another suggestion is that it is a bag of maize, but I think this is less likely due to its complex nature and the manner in which it is held. No indication of seeds are evident.

Gl. 1. Repeat of T1 followed by malevolent indications

Almanac 26 (pp. 6c–7c) Divinatory

T1. A death god is seated and holds a victim's head. He wears the pendant water lily motif.

T2. God D with a yellow face holds two affixes in a circle of dots that Thompson tentatively translates as *caca* refering to *Theobroma cacao,* and has a water lily head dress.

Gl. 1. Cacao.
Gl. 4. Abundance of maize.

T3. An anthropomorphic Muan bird is seated and has a water lily flower protruding from its forehead.

Almanac 27 (p. 8c) Divinatory

Commentary: These figures of gods or their impersonators are reminiscent of scenes from the Codex Bologna 12 13 and Codex Fejervary-Mayer 33–34 and suggest prophetic divination appropriate to a chilan. Thompson (1972) believes that the diminutive figures entering the temple are in a hallucinatory trance and suggests mushrooms (probably *Psilocybe* species).

T1. God D walks into a temple in which is seated God C as a small monkey-like figure who functions as the *katun* giving prophecy. Note *Nymphaea* in the head dress.

Gl. 1. Reddening all over. This may be due to the ingestion of some narcotic other than mushrooms. Such a flush is felt in *Datura*-intoxication.

Gl. 2. These glyphs convey the idea of half-dead. This is the trance state appropriate to a *chilan* during shamanic exstasis. This condition may have been due to drinking *balché* fortified with any of several narcotic plants to include *Datura, Psilocybe, Lonchocarpus* and *Nymphaea.* The idea of a single plant intoxicant is probably oversimplification.

T2. God Q walks into a temple with a *kaz,* or evil glyph inside.

Gl. 1. Reddening all over to once more imply narcotics. Painting the face red to imitate the *duende,* or spirit person is discussed by Thompson.

Almanac 28 (p. 9c) Divinatory

T2. The death goddess, probably Goddess O, is seated and wears a bilabiate flower in front of her head dress (*Sal-*

via divinorum?) and a water lily on the rear of it.
Gl. 1. abundance of maize

Almanac 29 (pp. 10c–11c) Divinatory

T2. God D is seen seated wearing over his head dress the pendant water lily motif that Thompson previously indicated as a centipede.
Gl. 4. This is interpreted by Thompson as Successor in Office or Lord of Recompense, indicating strong shamanic overtones.

T4. The seated maize god wears an unidentified flower on the terminus of his nose rod, or as a substitute for the more usual nose rod.
Gl. 2. Maize god
Gl. 3. Abundance of maize

T5. The seated sun god with a *kin* sign on his forearm wears a retrorse water lily in his head dress.

T6. God B is seated and makes elaborate gestures with his hands. The association with water is seen in the action glyph of the jade symbol surrounded by dots and the circles forming an arc in the head dress. This is further reinforced by the two water lily-like flowers in the rear of the head dress.
Gl. 3. Lord of the jaguar skin cushion; lord of the jaguar stool, may imply the water lily jaguar in this augury.

Almanac 30 (p. 12c) Divinatory

T1. God D, the diviner, is seen wearing the head dress of Chac. This establishes the divinatory nature of this almanac associated with the casting of lots.

T2. A seated Bacab holds the *kin* sign.
Gl. 4. Maize god

Almanac 31 (pp. 13c–14c) Divinatory

T3. The wife of God D is seated holding an animal whose nature is not identifiable and may be a transmogrified

animal or supernatural being. The head dress is unusual in that the pendant water lily now stands straight out from the headdress and emanates from a water glyph as indicated by the circle of dots.

T4. God L is seen seated wearing a head dress that includes a maize sign and a crested bird. Before him is a diminutive figure of the moon goddess holding a maize sign.

Almanac 32 (p. 15c) Divinatory

T2. God D is seated holding the *kin*, or sun (also priest or diviner) sign. The head dress has a pendant water lily that drops to meet the *kin* sign. It also emerges from a glyph suggesting water. Thompson indicates that Gl. 4 indicates one who divines by the casting of lots.

Almanac 33 (p. 16a) Divinatory

T2. The Lord of Vegetation who is probably the Moon Goddess in disguise.

Gl. 4. Maize god

Almanac 34 (pp. 16a–17a)

T1. God D with a *kan-imix* sign on his back indicating an abundance of maize or good fortune.

Almanac 35 (pp. 18a–19a) Divinatory

T5. Since almost all of the text of this almanac has been lost, the five divine goddesses are identified only by conjecture. T5 is of interest in that she wears a nose rod that terminates in an unidentifiable flower the base of which is comprised of a circle of dots which are used in water and sun signs.

Almanac 37 (pp. 21a–22a) Divinatory

T3. No depiction

Gl. 3. Abundance of maize

Almanac 38 (pp. 22a–23a) Divinatory

T1. A diving diety of uncertain character holds a maize glyph (he may be the maize god). His turtle head dress suggests aqueous elements as do the numerous *Nymphaea*-like motifs around the back of this figure. As with previous diving figures, he seems to share in some concept of magnical or divine vegetation.

Almanac 40 (pp. 17b–18b) Divinatory, medical

T2. This is a very elusive *T'ol* as there is no picture, but Gl. 1 of a monkey head with the down prefix and Gl. 4 suggest shaman, curer and Our Lady. There may also be a double meaning, not uncommon to this codex, Thompson points out that *maax (max)* is the name for both the spider monkey, for a variety of eruptions, inflammations and swellings, and for wild chile (*Capsicum*) of which there are several species in the Maya territory. The use of *Capsicum* fruits in shamanic divination is known from this area, and the plant serves effectively to help in healing as it is bacteriocidal and the vitamin C content would have helped to prevent a number of the diseases that are suggested by *maax*. The argument that there should then be portrayed a wild chile plant does not hold, for maize is most often mentioned but rarely portrayed except by the abstracted maize glyph. Capsacin is the active constituent in the fruit of the *Capsicum* plant.

Almanac 42 (pp. 19b–20b) Divinatory

T2. The seated moon goddess holds a small figure of God H before her. He wears the reflexed *Nymphaea* on his head and through his nose is a rod terminating in an unidentifiable flower.

Almanac 45 (p. 22b) Divinatory

T1. The youthful Chac is depicted as wearing the head of a dog and holding in his hand the maize sign.

T3. Goddess I is seated and holds the maize sign. In her hair is a knotted water lily.

T4. In the absence of a picture the glyphs indicate the rule of Chac. It is the assertion of Thompson that the signs indicate harm to the crops because even though Chac, the maize and the moon dieties are present, strong sun in the tropics is often harmful to crops. There are however a high proportion of favorable glyphs and auguries. This would be decidedly to the advantage of the shaman-priest in accounting for predictions. It allows a margin of error in that it is enigmatic.

Almanac 46 (p. 23b) Chants and offerings.

T2.

Gl. 1. Thompson suggests that the name *chai* is implicated both as a homonymn for obsidian and for *Jatropha aconitifolia* Mill. This member of the Euphorbiaceae was stripped of its leaves which were then boiled and eaten by the Maya. He also suggests *chaya,* another Mayan name for the same plant. Leaves had to be gathered at the correct time and then pressed. As many members of the Euphorbiaceae have toxic latex at maturity, this was probably a usual mode of treating the young leaves. Since a food glyph followed by the eating sign occurs in four of the five t'ols this is probably correct.

T3. While there is no picture, the glyphs implicate maize and eating.

T5. Glyphs only are present, and repeat T2 and add the maize god and his eating.

T6. Glyphs from T2 are repeated, as well as adding abundance of maize and his eating.

Almanac 47 (pp. 16c–17c) Divinatory, medical

T6. Gl. 4. Abundance of maize.

Almanac 49 (pp. 18c–19c) Divinatory

T1. A seated goddess has a well figured water lily in the front of her hair.

Gl. 1. Fainting, or epileptic fits were often considered a divine manifestation under control of the moon goddess (cf. our "lunatic").

T2. A seated goddess wears a fillet of water lily petals and two water lilies, one up and one down, extend from the front of this fillet.

Gl. 2. Her divine burden.

Gl. 3. Maize god.

Gl. 4. Abundance of maize.

Almanac 50 (pp. 19c–20c) Divinatory

T3. The seated goddess wears in her hair the "white" glyph with feathers emerging from it. I would take this to be *Nymphaea ampla,* the white water lily, with quetzal feathers inserted.

T4. The seated goddess carries the maize god on her back.

Gl. 1. The maize god.

Gl. 2. The divine burden of maize.

Gl. 4. Abundance of maize.

T5. A seated goddess carries a figure identified by Thompson (1972) as Sac Uacnal or "bursting forth of new white maize." (Gl. 1.)

Almanac 52 (pp. 22c–23c) Divinatory

T5. The moon goddess is seated opposite a death god. In his head dress is a complex of a frontal water lily that is a bird as viewed from the back. From above the eye of the bird are two mushroom-like projections. They are not the crest of the bird, and may represent sacred hallucinogenic fungi used in divination. The context of the glyphs suggest misfortune.

T6. A kneeling goddess has what Thompson has identified as a "white sign" in her hair. It would appear to be the

white water lily in a stylized presentation and turned to the back.

Gl. 1. Abundance of maize.

Almanac 53 (pp. 29a–30a)

T1. A Chac is seated on what Thompson has called "a world directional tree." Beneath him is a jar with a *cab* scroll indicating that it holds honey. I would conjecture that this association might imply *balche*[1] made from fermented jars of honey and utilizing the bark of *Lonchocarpus yucatensis* Pitt. and previously mentioned plants.

T2. A Chac is seated on what Thompson again identifies as a "world directional tree." Since the artist has taken the liberty to figure a pinnatifid leaf we might suggest that the plant is *Bursera* from which copal is derived. This was used in the most sacred Mayan ceremonies. The Chac wears a head dress of reversed water lilies that appear knotted.

T3. A Chac is seated on another tree so identified by Thompson as associated with a world direction. It has one flower pointed upwards and another down. The figuring of the flower is much like some of the water lily identifications made by Rands (1953). It may be a hybridized plant motif.

T4. The "world tree" portrayed here has protruding thorns on the trunk and is probably, as suggested by Thompson, a ceiba tree also known as the pochoté tree, *Ceiba aesculifolia* (HBK.) Britt. and Baker. Roys (1933) notes that in *The Book of Chilam Balam* it is stated (p. 91) "It is not bad to gnaw the trunk of the *pochote* tree."

Commentary: Thompson believes these pictures represent the Chacs seated on "the red tree of the east, the white tree of the north, the black tree of the west, the yellow tree of the south." He has not implicated *chacah* which may be a homonym closer than *chai* for the gods (i.e. Chac rain dieties). *Chacah* is mentioned in *The Book of Chilam Balam* as the wood comprising the first hut of the Canul family in "The Ritual of the

Four World Quarters." In this same work the white tree is *uaxim (guaje)* and is *Leucaena glauca* (L.) Benth. used in building. As mentioned previously, *chacah* is *Bursera simaruba* (L.) Sarg. figuring as copal. Thompson notes that all of these colors are also associated with the ceiba tree, a sign of fertility and abundance. However, it is clear from the pictures in the text that is not the ceiba tree that is figured in each instance. In the ritual of the Bacabs four surrogate plants become directional in the aformentioned ritual: the red *Plumeria acutifolia* Poir. is east, the white *Callisia repens* L. (or *Commelina elegans* HBK. is the north, the white flowered "black laurel" *Stemmadenia insignis* Miers. is the west, and the yellow flowered *Tecoma stans* (L.) HBK. is the south. This is a derived later manuscript, but it reinforces the idea that a single tree need not be used regularly in directional ritual. When the aqueous underworld is represented in the Dresden Codex it would appear that the white water lily is allowed to stand for all four directions. In the ritual of the Bacabs these colors also stood for the hues of the winds and were not to be taken in a literal sense.

Almanac 55 (pp. 31a–39a)

T2. An unidentified god kneels on the edge of a sort of boat. From the back of his neck a long pedicellate water lily is clearly figured. Opposite him is a Chac who appears to be holding a large water lily. Between them there is a vessel (*balché*?) with effluvia figured as coming from the top.

T3. The decapitated head of The Impersonator of Maize is on a three tiered altar. Three dieties play two different drums a rattle and a flute.

T4. God C posing as a Chac sits in a temple holding a maize glyph while a true Chac is on the ridge pole of the building.

T5. In front of a seated Chac are dishes of maize, a tall insence burner for copal (*Bursera*) and a vessel of foaming *balché*. The plant ingredients of *balché* have been discussed.

T6.

Gl. 4. Abundance of maize.

T7.

Gl. 2. Maize offering.

T11. This is the only known example of God X who has the attributes of the toad and the frog. In this picture, the god is a toad as the paratoid glands that contain bufotenine are depicted quite clearly and bear three black dots. In his head dress are the retrorse white water lilies. These are knotted, as is usually the case with a shamanic portrayal.

T13. Chac with a water lily head dress, knotted and reversed, embraces the moon goddess in a act of coition.
Gl. 4. Abundance of maize.

T14. A Chac sits on a jaguar skin dias contemplating a maize sign. In his hair are the appropriate water lilies.

T15. A Chac impersonates a dog carrying two torches. His head dress reveals his true identity and includes two vegetative forms.

T16. A Chac with a knotted, retrorse water lily head dress walks through the rain carrying a seed pouch.

T17.

Gl. 4. Abundance of maize.

Almanac 56 (pp. 40a–41a) Divinatory chant

T2. A Chac is seated on a large fish upon the back of which are motifs associated with the fruit of the ceiba tree, *Ceiba acuminata* (S. Wats.) Rose.

Gl. 4. This is down or cotton, probably from the ceiba fruit. Thompson suggests that it is clouds.

T3. Chac is seated on a tree and holds one of two branches. One root terminates in a Chac head, suggesting that this is some kind of sacred plant.

T4. A Chac with a water lily head dress sits on a tank or pool of water and holds an unidentifiable object.

T5. A Chac with a water lily to the front and a knotted water lily to the rear, sits on the head of God D and is

clad in a turtle shell mantle.
Gl. 3. Abundance of maize.

T6. A Chac with a water lily head dress sits inside a small temple or hut.

Almanac 57 (pp. 42a–44a) Chant (not augural).

T1. A Chac sits on a coiled rattlesnake upon the head of which rests a vessel with three maize signs above it. The Chac has a single retrorse water lily in his head dress.
Gl. 5. Maize and ?

T4.

Gl. 5. Maize.

T5.

Gl. 5 Maize.

T7. A Chac with a retrorse water lily head dress holds a fish.

T8. A Chac is seated in a small temple and wears the retrorse water lily head dress.
Gl. 4. Abundance of maize.

Almanac 58a (pp. 30b–31b)

T1.

Gl. 5. Venison and maize.

T3.

Gl. 5. Iguana and maize.

Almanac 59 (pp. 31b–35b) Divinatory chant

T1. A Chac with water lilies in front and back of his head dress walks with a torch and seed pouch (?) in imitation of a Bacab.

T2. A Chac with elaborate water lilies in his head dress is seen walking.
Gl. 4. *Theobroma Cacao* L.

T3. A Chac with torch and axe and frontal water lilies in his head dress.
Gl. 6. Maize god.

T7.

Gl. 5. Abundance of maize.
Gl. 6. Maize seed.

T8. The head of God B is attached to the body of a snake which is so devised as to encircle a body of water. In the head dress of God B is the retrorse water lily, and from the four corners of the lake there are protrusions suggesting what Rands (1953) identified as the "mammiform water lily." I would support this identification and suggest that the water lily in this context takes on the meaning of the directional trees, colors, winds, etc., that are typically Mayan. The association between the water lily and the serpent was pointed out by me (1979), and the serpent may be *Hapi Kan*. There is a seed pouch in his right hand. The festival is *u hanli*.

Almanac 60 (pp. 35b–37b) Divinatory chant

T2.

Gl. 4. Glyph of maize god, *Uaxac yol kauil*

T3. A Chac paddles a canoe containing a goddess, who wears a peculiar water lily frontally.
Gl. 1. A dessicated maize crop.

T6. A Chac walks holding a vegetal form that defies identification.
Gl. 2. Abundance of maize.
Gl. 4. Wood *(che)* of chastisement.

T7. A Chac, seated on water, grabs an eel or a water snake. He wears the retrorse water lily head dress. Beneath the water a bacab (or perhaps God N) emerges from a conch shell. On the front of his head band is a water lily.
Gl. 3. Chastisement over *balché*.

Almanac 61 (pp. 38b–41b) Augural weather almanac

T2. A Chac with the retrorse water lily head dress is sowing seed in the rain.
Gl. 3. Abundance of maize.

T5. A Chac with a planting drill walks with an open hand as though planting seed.
Gl. 4. Abundance of maize.

T6. A Chac with a retrorse water lily head dress is seated in a rain that falls from celestial bands.
Gl. 4. Woe to the maize.

T7. A Chac dives from a celestial band with an axe in his hand in a manner similar to previously figured diving personages.
Gl. 3. Maize god.
Gl. 4. Abundance of maize.

T9. An anthropomorphized toad-dog dives from a celestial sky. Thompson interprets this figure as a dog for reason of the associated second glyph *"pek"* which may mean either dog or unfavorable weather. The form, the long extended tongue and the water lily flowing up from the head all suggest a toad. The large dark patches may be death patches or an attempt to further reinforce the toad motif. We must not rule out a hybridization of forms.
Gl. 4. Woe to the maize seed.

T10. A bacab is seated in a conch shell and water is all about him. He wears one frontal protruding water lily. A more stylized water lily is seen on the back of the conch shell. In the latter instance the conch shell with a water lily on it was regularly associated with the old God N.

T11. A Chac wearing a complex head dress with a maize glyph and a frontal water lily sits cross legged in the rain. His mantle suggests the shell of a turle (this is attested to in Gl. 1.).

Almanac 62 (pp. 41b–43b)

T1. A Chac kneels before a tree and is in the act of cutting it down. The base of the swollen tree is the head of a Chac. The suggestion may be that of *Chac-ya,* the red sapote used in an incantation, *(Ritual of the Bacabs)* for obstruction of the breathing passages. *Calocarpum*

viride Pitt. has a red pulp and is still much esteemed among the Indians of Guatemala. *Chacte,* if intended, implicates *Caesalpinia platyloba* S. Wats., a tree used to make a dye as well as staffs.

Gl. 5. *Balché*(?)

T2. A Chac squats over a tree that emerges from between his legs.

Gl. 2. Abundance of maize.

T3.

Gl. Fresh chocolate *(Theobroma Cacao)*

T4. A Chac, planting drill in hand, sits astride a tapir-like animal head. His head dress is the retrorse water lilies.

Gl. 4. The maize god.

Gl. 5. Abundance of maize.

T5.

Gl. 4. Abundance of maize.

Gl. 5. Maize beetle grub.

Almanac 63 (pp. 44b–45b) Divinatory

T1.

Gl. 6. Maize seed.

T2.

Gl. 5. Copal (*Bursera simaruba* L.)

Gl. 6. Iguana and maize dish.

T3.

Gl. 5. Fish and maize.

Gl. 6. Food, but especially maize.

Almanac 65 (pp. 30c–33c)

T1. A Chac with an axe and a seed pouch is seated on the red, world directional tree.

Gl. 1. *Chacte.* This is the Brazil Redwood, *Brosimum paraense* Hub. Thought to have originated in tropical South America, this tree was introduced into Maya territory at some early date. It is also known as breadnut, for the seeds are eaten after being boiled.

T2. A Chac is in a diving position on top of the yellow world directional tree of the south.

Gl. 3. *Ti kante* (at the yellow tree). *Kante* is listed in the Motul Dictionary as a tree the roots of which yield a yellow dye. Roys (1931) states that in Peten this is the tree with yellow flowers; however in Yucatan it is a tree the roots of which yield a yellow dye. Although this tree goes unidentified, I would suggest that it is either *Chlorophora tinctoria* (L.) Gaud. of the Moraceae, the root bark of which produces a yellow dye still used under the name "fustic," or *Podocarpus oleofolius* D. Don. of the Podocarpaceae. Both have appropriate patterns of distribution and can be used as dyes.

T7. God C is seated on top of an *Agave* with an axe in his hand. Thompson finds "identities of plant and deities pictured questionable." I would point out that in the *Ritual of the Bacabs* the *ci,* or *Agave,* is used to pierce the tongue (IV:32). In this same work, there is mention made of *balam-kuch-ci,* the jaguar-vulture-agave that is useful in treating trantula eruptions and seizures. The scene depicted in the Dresden Codex seems obviously shamanic. The association of *Agave americana* L. with the shaman is implicit in its association with the jaguar and vulture. To sit above an *Agave* is an impossible feat that could be accomplished only by a powerful shaman, as the leaves are like bayonets. The rattle in the hand of God C implies ceremonial importance. In a more mundane vein, it should be noted that the fiber of this plant was used extensively by the Maya.

T8. A Chac is seated inside the trunk of a hollow tree. Water has accumulated and and the Chac floats upon it.

Gl. 3. *Kakche* is the ebony tree, *Diospyros ebenaster* Retz., also known as the black sapote. Although this is not one of the tree that is usually hollow

at maturity, the suggestion would seem to be that the spirit of a Chac dominates this directional tree.

T9. A Chac wearing the head dress of retrorse water lilies is astride a tree with an axe in his hand. Neither the picture nor the corresponding glyphs identify the tree. Thompson notes the absence of white in the four directional trees. I would point out that this is the only figure that wears the white water lily head dress in this tetrology. This completes the four necessary colors in this almanac.

Almanac 66 (pp. 33c–39c)

T1. A Chac with double retrorse water lilies in his head dress sits under a sort of temple on a dias. He holds a vessel over which there is a maize glyph.

T2. A Chac sits on a sky glyph around which a water lily plant seems to climb. This is called by Thompson a "dubious element."

T7. A Chac sits on a sky glyph and studies a maize glyph in his hand.

T10. A Chac in a pool wears water lilies in his head dress and pours water from a jar which will be magically replenished.

T14.

Gl. 3. *ti tanam men* is translated as "on the fleecy clouds." In a stricter sense, *tanam* is cotton, *Gossypium mexicanum* Tod. of the Malvaceae.

T16. A Chac is seated in a temple with the *cauac,* grape element, conspicuous. Either *Vitis discolor* Dalz. or *V. sicyoides* L. may be indicated. In both the stems make good cordage or may be used in basketry. The leaves produce a lather useful in washing, and a decoction of the stem is used to cure rheumatism.

Gl. 4. indicates a mat woven possibly from cordage of *Vitis* (see above).

T20. A Chac with retrorse water lilies in his head dress sits holding a maize glyph. He is positioned above a pond of water.

Almanac 67 (pp. 40c–41c)

T1. A Chac with a single retrorse water lily in his head dress paddles a canoe.

T2. A Chac with a vessel of burning copal (*Bursera simaruba* sits on the earth sign. Above the vessel is the *ich* sign for burning copal.

T3.

Gl. 4. Maize offering. Thompson believes that the nodules around the sign may represent copal.

T4.

Gl. 4. A turkey head emerges from the maize sign.

T5.

Gl. 4. Red maize.

Almanac 68 (pp. 42c–45c) Divinatory

T1. A Chac with red body and a water lily in the back of his head dress is in the process of defeating the maize god.

Gl. 4. Maize god.

Gl. 5. Maize god.

Gl. 6. Woe to the maize god.

T2. A Chac paddles a canoe and behind him is a dish of maize with an iguana over it.

Gl. 5. Fresh maize seed.

Gl. 6. Abundance of maize.

T3. Two Chacs, each with water lily head dresses are involved in a game or battle in which cords are whipped about and become entwined.

Gl. 5. Maize god.

Gl. 6. Abundance of maize.

T4. A Chac disguised as God B is astride a deer that is dying of thirst, an augury of great drought. The Chac has two retrorse water lilies in his head dress. In his hand are two feathery objects. Thompson suggests that

they might be torches. They are not red as is usual with most fire depictions.

Almanac 69 (pp. 65a–69a) Divinatory

T1. A Chac stands with a raised axe and shield as though prepared for combat. In his head dress are the two retrorse water lilies.
Gl. 6. Maize god.

T2. A Chac, with the retrorse water lily head dress, walks carrying a sort of cornucopia of seed (cacao beans?) from which there is suspended a long-pedicellate water lily in bud, showing the three-parted calyx, still another representation of this flower. Since glyph 5 suggests dark water, it lends support to the identification inso-much as water lilies must grow in still water. Streams, rivers or seas will not support their growth.

T3. A Chac wearing the head dress of God K, including water lilies, stands grasping a fish.
Gl. 5. Abundance of maize.
Gl. 6. Time of the maize god.

T4. A Chac with a water lily head dress is dressed for combat.

T6.
Gl. 6. Woe to the maize god.

T7.
Gl. 4. Cotton thread.

T8. A Chac walks with spear and seed bag.

T9. A Chac holds a sac containing what has been suggested by Thompson as God K about to be born. Accompany-ing glyphs indicate cotton and black together which Thompson takes to be clouds. Certainly the opening of the fruit of *Gossypium* suggests birth and the fibers might suggest the placenta in which is found the seed.
Gl. 6. Maize god.

T10. Two Chacs, each with one white water lily in his head dress, sit back to back. One is in the rain.
Gl. 5. Good tidings for maize.

T11. A sky beast is seen dropping from a celestial band above the maize god who holds in his hand a compound "abundance of maize."
Gl. 3. Maize god.
Gl. 6. Abundance of maize.

T12. God C is seated in the rain holding a maize sign.
Gl. 5. *Balché*
Gl. 6. The maize god.

T13. A Chac with an axe is seated on the spiny ceiba tree and it seems to make up the lower half of his body (tree of life). His hand holds the left blue side. The right side is red.

Almanac 70 (pp. 65b–69b)

T1. A Chac paddles a canoe below which is an eel. The Chac wears the stylized water lily head dress.
Gl. 5. Much new maize.

T2. A Chac spear thrower with water lilies in his head dress walks through the clouds.

T3. A Chac with a staff and back pack walks a non-material road.

T4. A Chac wearing water lilies in his head dress sits in a celestial chair.

T5. A Chac with a water lily head dress is seated on a monstrous head.

T6. A Chac with water lilies on his head dress sits over an oblong enclosure of crossed bones, possibly the underworld.
Gl. 5. Maize.

T7. A Chac with a seed pouch sits on what Thompson calls a *yaxche* tree. He wears the water lily head dress.
Gl. 2. *Yaxche,* the giant ceiba tree.

T8.
Gl. 4. White maize and water, the maize drink, *zaca* or *atole.*
Gl. 5. Decomposed maize, or turtle and maize.

T9. A Chac holds a water lily with a long pedicel above a lake in which there is fish and a conch.
Gl. 4. Abundance of maize.
Gl. 5. New maize.

T10. A Chac with a single retrorse water lily in his head dress drums on a turtle carapace.
Gl. 5. New maize.
Gl. 6. There is no eating of new maize.

T11. A Chac holds the moon goddess in a posture of coition. He wears the two retrorse water lilies in his head dress.

T12. A Chac with the traditional two water lilies in his head dress is seated on two fire symbols and holds a seed pouch.
Gl. 5. Lime maize (i.e., maize seed treated with lime to remove the hull).

T13. A Chac with the two water lilies in his head dress holds a large bird and appears to be seated in clouds.
Gl. 5. New maize.

Almanac 71 (pp. 53a–58a and 51b–58b)

Although these are not arranged as the other *t'ols*, as the eight to ten glyphs above each picture are in a category that is different from the pairs of signs in each column, they will be numbered as are the other almanacs.

T1. A death god is seated on a chair of bones with his hand raised in a prophetic gesture. From his frontal brow is a water lily with emanations that resemble smoke or quetzal feathers. It would seem to concern a lunar eclipse.

T2. The jaguar-sun god is depicted by a portrait of his face in a series of bands. These seem to be rooted at the base and from them four floral or vegetative motifs protrude. These are probably directional motifs. Since the glyphs suggest rain and unmitigated grief, the water interpretation of the bands seems to me better than Thompson's suggestion that they are planetary bands.

T3. This depiction of the head of the sun god with jaguar whiskers seems akin to the previous one. He is set in a

similar cartouche of two areas of water, one light and the other dark from the four corners mammiform water lily buds protrude as directional flowers. A celestial band is above. The text seems to have confounded Thompson and others. I would not presume to explain the context of these, but I believe that my explanation of the water lilies as directional flowers and the water cartouche may assist others in expanding upon this.

T4.

Gl. 4. The lands of maize (woe to).

T5. A vegetal form supports two areas, one dark the other white. These are crossed with diagonally placed flower-tipped rods. The internal structure of the dark area suggests rivers. The same image is metamorphosed in five different *t'ols*. The suggestion of eclipse is evident as is misfortune. Thompson concludes that it is a puzzling text.

T6. The goddess Ixtab manifested as the moon goddess is seen hanging from a halter. Thompson suggests that this goddess has her eyes closed in death. Another possibility is the representation of a trance state in which Ixtab (moon goddess alter ego) leads victims to a paradise that is the Maya equivalent of Tlalocan. This is reinforced by Gl. 1.

Gl. 1. *Balché*

T7. From a celestial band hang two "sacs," on black the other white (cf. 55a, 56a, 57a, 56b, 57b, and 52b). These "sacs" are seen in various stages of metamorphosis. I have already suggested a connection with water, moving and still. In the center is the *kin* sign and two bones cross the black half. Both areas terminate in root-like or rivulet-like bases. The frequency of animal heads among the glyphs, all with protrusions of sorts, and the central *kin* sign associated with ritual divination suggest a magical context. A prophecy of evil is implicit. The frontal protrusions on the animal glyphs are reminiscent of the Chac-water lily association.

T8. See commentary T7.

T9. See commentary T7.
T10. A humanoid figure in the form of a frog-toad is seen in a diving position. His head is replaced by a Venus sign above which is the double knotted water lily. The knife-like protrusion emanating from the rear is suggested by Thompson to be a knife. It may be a symbol of the toad shaman metamorphosis.

I would like to point out that while I have concentrated my attention upon those plant attributes of this almanac (71), I am not unaware that the overall theme of this Venus and lunar presentation is that of eclipse, hence the light and dark sacs, so that shaman priests could carry out their divination.

At this point, I must adhere to the system followed by Thompson discarding Almanacs 72 and 73 of Gates (1932) and adding 76 and 77.

Almanac 74 (pp. 71f–73c) Agricultural Divination
T10.
Gl. 4. Maize seed

Almanac 75 (73b *left* to 71 and 73c left to 71c—column F)
T2.
Gl. 2. Woe to the maize seed.
T3.
Gl. 3. Maize seed.
T7.
Gl. 3. Abundance of maize.
T10.
Gl. 3. Abundance of maize.
T11.
Gl. 3. Woe to the maize god.
T13.
Gl. 3. Maize seed.
T16.
Gl. 3. Abundance of maize.

Almanac 75 (pp. 73b right leftward to 71F)

T2.

Gl. 2. Woe to the maize seed.

T3.

Gl. 3. Maize seed.

T7.

Gl. 3. Abundance of maize.

T10.

Gl. 3. Abundance of maize.

T11.

Gl. 3. Woe to the maize god.

T13.

Gl. 3. Maize seed.

T16.

Gl. 3. Abundance of maize.

T21.

Gl. 2. Maize seed.

T22.

Gl. 2. Woe to the maize seed.

T24.

Gl. 2. *Zaca*, the maize drink; probably fermented into a beer.

Gl. 3. The maize god.

T25.

Gl. 1. *Koch*. According to Roys (1933) *koch* or *ix-koch* is now applied to the castor bean (*Ricinus communis* L.) which was introduced from Africa. The original *kaxil-ix-koch* is uncertain, but was used in divinatory cures for asthma.

Almanac 76 is page 74 and depicts a torrential rain pouring from the mouth of a celestial alligator with humanoid forearms terminating in the cloven hoofs of the sacred deer. The old goddess Xkita pours more water from a vessel. According to Thompson (1930), she was ancestor of sun and moon. Black God L is also depicted.

Gl. 15. Maize seed.

SUMMARY

While many of the plant entries figured in the Dresden Codex relate to food, most especially maize, it is noteworthy that the narcotic *Nymphaea ampla* of that region is prominent in its appearance in this Codex in ritual context. Its narcotic properties have been discussed by Emboden (1981, 1982) in the context of ritual use. I would assert that the diving Chac motif that is so frequent among the figures in the Dresden Codex as well as in Mayan ceramic representations is emblematic of that figure that goes into the aquatic underworld where *Nymphaea* grows. The Chac is sometimes metamorphosed into a toad, a toad-dog hybrid form, a jaguar or the toad-frog (God X). The jaguar has been called the "water lily jaguar" by Coe (1973), as it is often associated with the water lily; and the frog and toad are both metamorphic creatures associated with shamanic transformations. The further implication of such narcotics as *Ipomoea violacea, Turbina corymbosa, Salvia divinorum* and *Psilocybe* species lend credence to the assertion that this is a catalogue of divinatory plants as well as a calendrical document. Even *Nicotiana undulata* must be included in a catalogue of narcotics used in a ritual context given the known potency of this tobacco. Furst (1976) presents an excellent exposition of this thesis.

In summation, we may now view this Codex from another standpoint: that of presenting the magico-divinatory aspects of the life of the people who produced this extraordinary document as revealed by the prominent position of plants having narcotic properties figuring into the imagery of the Codex. Much remains to be deciphered with respect to this formidable document. Perhaps some of the assertions presented here will be an adjunct to further research on one of the most precious pre-Cortesian codices, and indeed, one of the most important documents of the early Americas.

ILLUSTRATIONS

The frequency with which plant motifs are figured in the Dresden Codex necessitates the reader's consultation of a published edition. The figures selected are but a fraction of those

noted. The images have been redrawn over magnificants of the originals using alcohol based ink. Every effort has been made to avoid modification of any imagery.

PLATE 10

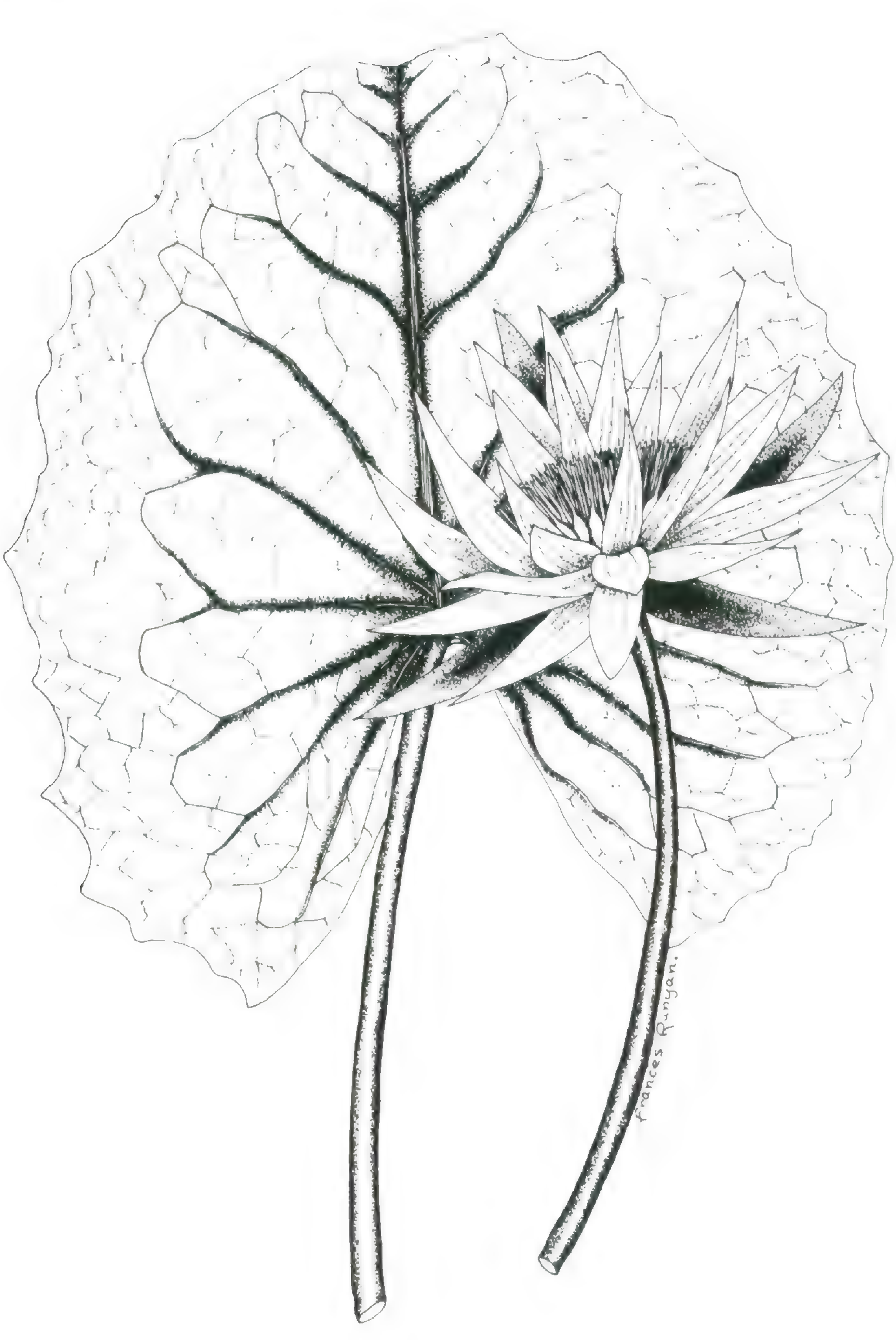

Plate 10. *Nymphaea ampla* DC., The white water lily of the Maya. Drawn by Frances Runyan.

PLATE 11

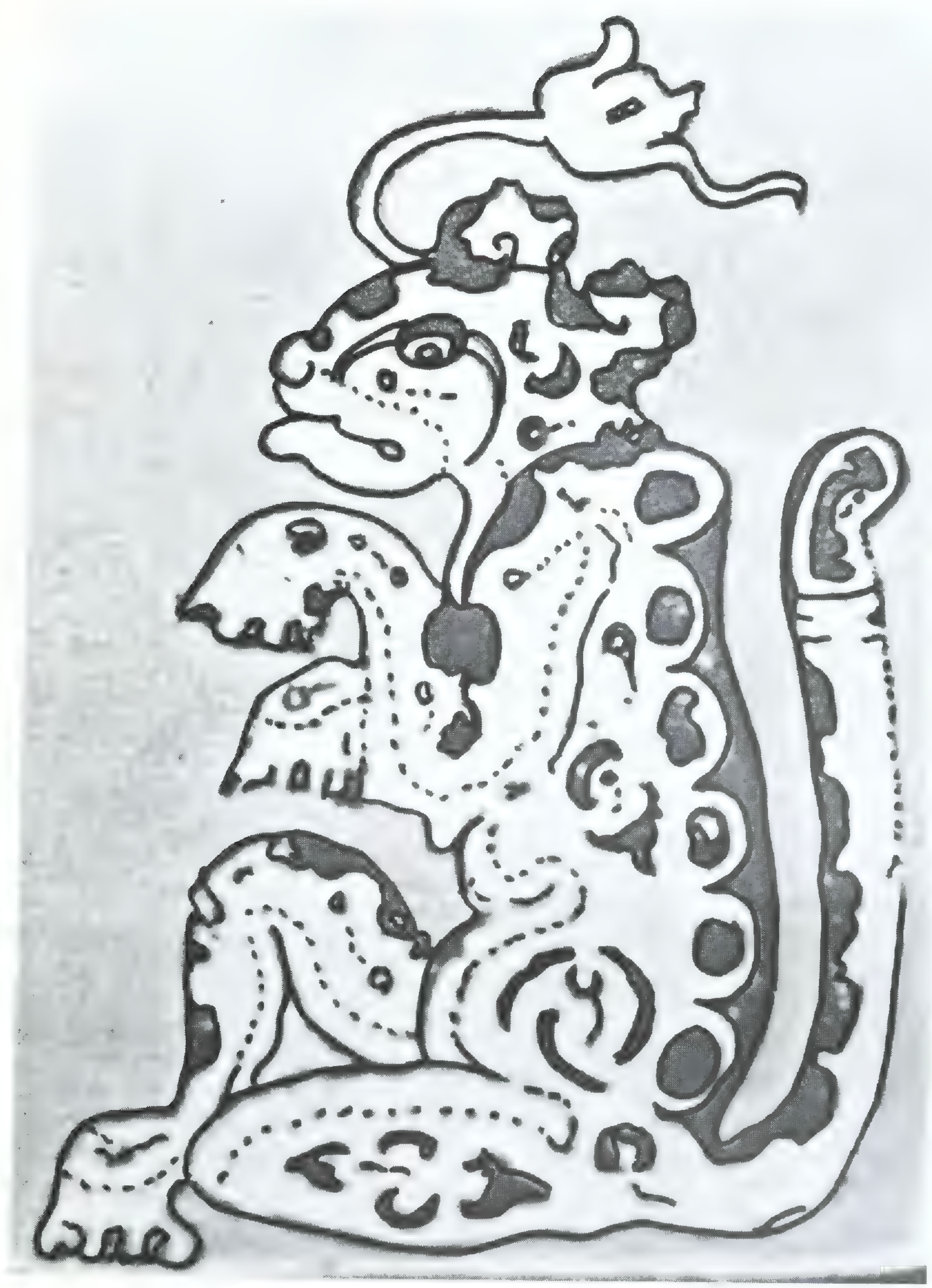

Plate 11. Chapter I, Series 1, 8. The Water Lily Jaguar wearing the retrorse blossom on his head.

PLATE 12

Plate 12. Chapter II, Series 1, 19. The Moon Goddess, with two protruding and three retrorse water lilies in her head dress.

PLATE 13

Plate 13. Chapter IV (The Planet Venus) 48. A complex head dress utilizes pods of *Theobroma* as well as *Nymphaea* with inserted quezal plumes. The original is in color (unusual for this codex).

PLATE 14

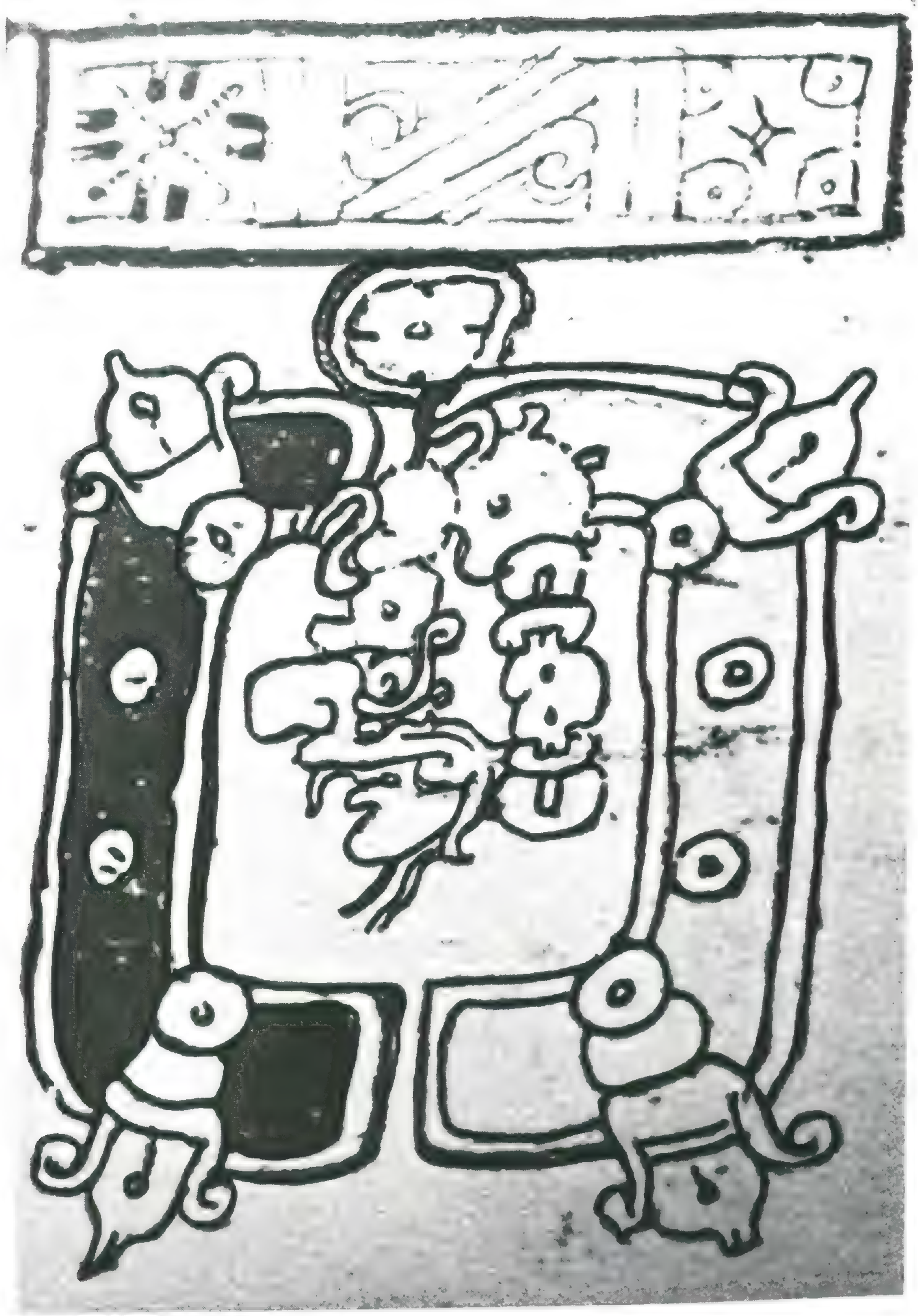

Plate 14. Chapter V (Lunar Tables) 56. The four cardinal points are indicated by the water lily buds. These are connected to a water lily leaf. A leaf, or pad, motif is seen above as well.

PLATE 15

Plate 15. Chapter X (New Year Ceremonies) 25. The masked diety has three water lily buds inserted into each other in his head dress. The context is the ritual offering of *balché* and comestibles.

PLATE 16

Plate 16. Chapter 10 (Farmer's Almanacs) 29. A masked diety is seated on a vegetal mound. Before him are two water lilies and a water lily protrudes over his brow.

PLATE 17

Plate 17. Chapter XI (Farmer's Almanacs) 33. A chac is seated over water within a sacred well or lake. Above the masked figure are leaves that suggest the narcotic *Turbina corymbosa*, the seeds of which provoke hallucinations.

PLATE 18

Plate 18. Chapter XII (Farmer's Almanac) 40. A diving jaguar, bearing a torch and wearing a water lily head dress, enters the realm of the underworld.

NOTE: To be inserted after page 132 in binding.

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BOTANICAL MUSEUM LEAFLETS
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VOL. 29, NO. 2

DE PLANTIS TOXICARIIS E MUNDO NOVO TROPICALE COMMENTATIONES XXXI

FURTHER ETHNOPHARMACOLOGICAL NOTES ON MALPIGHIACEOUS PLANTS OF THE NORTHWESTERN AMAZON

RICHARD EVANS SCHULTES

A number of years ago, I published an article entitled "Notes on toxic or medicinal malpighiaceous species of the Amazon" in Bot. Mus. Leafl., Harvard Univ. 24 (1975) 121–131. These notes were based on collections identified by Dr. José Cuatrecasas of the Smithsonian Institution—identifications published in his monograph of the Malpighiaceae of Colombia in Webbia 13 (1958) 343–664.

During the ensuing eight years, additional collections of this family have been distributed and identified. At present, a total of 112 of my numbers have been determined by Dr. William R. Anderson of the University of Michigan—a much more extensive selection than was available to Dr. Cuatrecasas. These identifications have been published in his "The Botany of the Guiana Highlands—Part XI Malpighiaceae" in Mem. N.Y. Bot Gard. 32 (1981) 21–305.

It is now possible to offer additional notes on the uses of malpighiaceous plants of medicinal or toxicological nature by Indians in the northwest Amazon. Only occasionally have name changes been made. Thus, in great part, there is little need to alter the citation of the notes which I published earlier.

My deepest appreciation goes to Dr. Anderson for the care and interest which he has shown in studying my malpighiaceous collections. The ethnopharmacological observations are the result of my field research in the Colombian Amazonia from 1941 through 1954.

The genera and species are arranged alphabetically. The specimens cited are deposited for the most part in the Gray Herbarium

or the Economic Herbarium of Oakes Ames at Harvard University or in the Herbario Nacional Colombiano in Bogotá, Colombia.

Burdachia Duckei *Steyermark* in Fieldiana Bot. 28 (1952) 282.

BRAZIL: Estado do Amazonas, Rio Negro, Ilha Gavião, near mouth of Rio Branco. July 7, 1967. *Schultes 24531*.

This plant is believed to be toxic by the natives of the region where the collection was made.

There is, however, no chemical indication of the presence in the genus of a toxic constituent.

Burdachia prismatocarpa *Adr. Jussieu* var. **loretoensis** *Anderson* in Mem. N.Y. Bot. Gard. 32 (1981) 143.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. October, 1946. *Schultes et Black 8400*.

The Tikuna Indians formerly employed the bank of this plant in preparing an emetic drink for use by chronic sufferers of stomach pains.

Byrsonima arthropoda *Adr. Jussieu* in Ann. Sci. Nat., ser. 2, 13 (1840) 335.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Soratama. June 15, 1951. *Schultes et Cabrera 12562*. —Jinogojé. *Schultes et Cabrera 19815*. Comisaría del Amazonas, Río Amazonas, Leticia. *Schultes et López 10400*.

The bark of *Byrsonima arthropoda* is crushed, soaked in warm water and poulticed on deep cuts to hasten healing amongst the Makuna Indians of the Río Piraparaná.

It is of interest that natives in British Guiana are reported to use the inner bark of *Byrsonima crassifolia* (L.) HBK. for a similar purpose (*A.C. Smith 3344*).

Byrsonima japurensis *Adr. Jussieu* in Ann. Sci. Nat., ser. 2, 13 (1840) 335.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Raudal Yayacopi. February 1952. *Schultes et Cabrera 15507*.—Jinogojé. *Schultes et Cabrera 16594*.

The Makuna Indians value *Byrsonima japurensis* in the form of a tea as a strong vermifuge.

Diacidia galphimioides *Grisebach* in Martius, Fl. Bras. 12, pt. 1 (1858) 120.

COLOMBIA: Comisaría del Vaupés, Río Kuduyarí, Cerro Yapobodá. "Low bush, 1-2 feet tall. Flowers yellow." October 5-6, 1951. *Schultes et Cabrera 14355*.—Same locality. April 1953. *Schultes et Cabrera 20049*.—Río Karurú, Mesa de Yambí, Savannah Goo-ran-hoo-dá. "Bush. Flowers bright yellow." April 15-16, 1953. *Schultes et Cabrera 19170*.—Río Vaupés, between Mitú and Javareté, Cerro de Tipiaca. "Low bush. Flowers yellow." May 14-24, 1953. *Schultes et Cabrera 19314*.

A tea of this plant is said to be strongly astringent and to be used by the Kubeo Indians as a remedy for colds and bronchial conditions in which the throat is affected.

Diacidia parvifolia *Cuatrecasas* in Webbia 13 (1958) 632.

COLOMBIA: Comisaría del Vaupés, Río Kuduyarí, Cerro Yapobodá. *Schultes et Cabrera 14355*.—Río Kubiyú, Cerro Kañendá. "Flowers yellow." November 10, 1952. *Schultes et Cabrera 18307*.

The leaves of this small shrub are collected by the Kubeo Indians of the Río Kuduyarí, dried and pulverized and worn in pockets in the belief that they ward off snakes.

Heteropterys sp.

COLOMBIA: Comisaría del Putumayo, Río Putumayo, Puerto Ospina. "Extensive liana along river's edge. Said to be very toxic; not employed." July 5-8, 1942. *Schultes 4029*.

The common name of this liana in the upper Putumayo area is *mataperro* ("dog killer"), indicative of its extreme toxicity. The plant is, however, apparently not utilized.

Heteropterys acutifolia *Jussieu* in Arch. Mus. Paris 3 (1843) 459.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Raudal de Jirijirimo. "Small tree. Flowers yellow." March 15, 1952. *Schultes et Cabrera 15944*.—Comisaría del Amazonas, Río Miritiparaná, Caño Guacayá. "Vine. Wings of fruit pinkish." April 24, 1952. *Schultes et Cabrera 16248*.

The Makuna name for this plant is *wj́-ka-hee-ma*.

Heteropterys macradena (*DC.*) *Anderson* in Mem. N.Y. Bot. Gard. 32 (1981) 202.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Miraflores. April 20, 1943. *Schultes 5371.*

A tea of the leaves of this species is valued amongst the Indians of the Río Vaupés to reduce "blood in the stool."

Heteropterys nervosa *Adr. Jussieu ex St. Hilaire*, Fl. Bras. Merid. 3 (1832) 26.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Soratama. August, 1951. *Schultes et Cabrera 13770.*

Indians living in the Río Kananarí bathe the feet with a hot decoction of the bark of this liana to help heal cracks in the thick skin that are chronically infected. The Taiwano name is *mateé-na-ne.*

Heteropterys olivacea (*Cuatr.*) *Anderson* in Mem. N.Y. Bot. Gard. 32 (1981) 178.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Raudal de Jerijirimo. November 25, 1951. *Schultes et Cabrera 14591.*

The Taiwanos of the Río Kananarí make a solution of the leaves of *Heteropterys olivacea* soaked in an oil (possibly of *Jessenia Bataua*) to "cure" deafness by repeatedly dropping it into the ears.

Heteropterys siderosa *Cuatrecasas* in Webbia 13 (1958) 476.

COLOMBIA: Comisaría del Vaupés, confluence of Ríos Ajaju and Macaya (Puerto Hevea). July 23,1943. *Schultes 5646.*

The Karijona Indians of the uppermost Río Vaupés believe that the crushed leaves of *Heteropterys siderosa* rubbed vigorously on painful joints will reduce inflammation.

Lophanthera pendula *Ducke* in Trop. Woods 50 (1937) 34.

BRAZIL: Estado do Amazonas, Río Negro, São Felipe and vicinity. January 8, 1948. *Schultes et López 9600.*

The leaves of this small shrub in tea form are considered to be a strong diuretic by the Brazilian inhabitants of the upper Río Negro where the vernacular name of the plant is *muruci*.

An alkaloid—lophantherine—has been reported from *Lophanthera latescens* Ducke, but its structure is still unknown (Hegnauer: *Chemotaxonomie der Pflanzen* 5 (1969) 25).

Mascagnia Benthamiana (*Griseb.*) *Anderson* in Mem. N.Y. Bot. Gard. 32 (1981) 217.

COLOMBIA: Comisaría del Amazonas, Río Karaparaná, entre las bocas y El Encanto. May 22-28, 2943. *Schultes 3827a.*

The Witoto Indians give a drink prepared from the samaras of *Mascagnia Benthamiana* to stimulate the appetite following serious malaria.

This is the first collection of *Mascangia Benthamiana* from Colombia, and the locality is far to the west of the general range of the species.

Mascagnia castenea (*Cuatr.*) *Anderson* in Mem. N.Y. Bot. Gard. 32 (1981) 218.

BRAZIL: Estado do Amazonas, Rio Negro basin, Rio Dimití, at base of Cerro Dimití. May 12-19, 1948. *Schultes et López 10014.*

Natives living along the uppermost Río Negro consider the bark of this liana toxic and assert that it was formerly employed with other plant ingredients in preparing curare.

This plant, first described as a species of Heteropterys, has been known hitherto only from the type collection.

Tetrapteris styloptera *Jussieu* in Ann. Sci. Nat., ser. 2, Bot. 13 (1840) 262.

COLOMBIA: Comisaría del Amazonas, Río Miritiparaná, Caño Guacayá. "Flowers yellow. Vine." March 2-8, 1952. *Schultes et Cabrera 15784.*

The Tanimukas, who call this vine *weé-po-awk*, employ the bark in powdered form as a styptic.

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PREPARATION OF THE HAITIAN ZOMBI POISON

E. WADE DAVIS

For many years travellers to the Caribbean island of Haiti have returned with sensational reports of *zombies*, the so-called living dead of the Voudou society. According to these popular accounts *zombies* are innocent victims, raised in a comatose trance from their graves by malevolent Voudou priests (*bokors*) and forced to toil indefinitely as slaves.

Serious students of Haitian culture, while noting that the vast majority of the peasantry believes in the physical reality of *zombies*, have usually considered the phenomenon as folklore (Herskovits 1937, Leyburn 1941, Mars 1945, Bourguignon 1959, Métraux 1959, Courlander 1960). Certain writers, however, have postulated a material basis for zombification (Hurston 1938). This basis is a reputed poison acting dramatically to lower metabolism and simulate death so much so that the victim is buried alive and later resusitated with an antidote administered by the bokor in the graveyard. (Hurston 1938, Leyburn 1941, Métraux 1959). Scientific interest in this zombi poison was recently stimulated by three cases of zombification, one of which may represent the first potentially verifiable instance (Douyon 1980, Pradel and Casgha 1983, Davis 1983). Physicians familiar with these three cases, fully cognizant of the medical potential of such a drug, asked me in the spring of 1982 to investigate its organic composition in Haiti.

During the course of three expeditions, the complete preparation of five poisons used to make *zombies* was documented at four widely separated villages in Haiti. Although each locality has an unique formula for the poison, botanical and zoological determination of the voucher specimens indicates that the principle ingredients are consistent at three of the four localities and in four of the five poisons. The formulae for the antidotes, on the other hand, show no consistency in these widely separated localities.

The ingredients and preparations discussed here were collected at three representative sites: the environs of Saint Marc and Gonaïves in the Artibonite valley of central Haiti, and the third on the Plain of Leogane, south of the capital of Port-au-Prince.

For the Voudouist, the creation of a *zombi* is essentially a magical act (Davis 1983) and thus prior to the preparation of each poison, the participants must seek spiritual and material protection. While this may be a simple matter of the *houngan*, or benevolent Voudou priest, rubbing a magical solution on each individual, it can involve rather elaborate ritualistic cleansings as well as the preparation of protective magic potions. At a small coastal fishing village, for example, this initial stage of the elaboration of the poison was particularly complex, as the following excerpt from my journal indicates:

> "The *houngan* began by dipping a small pre-Columbian axe-head, known to the Voudouist as a *pierre tonnere*, into a strong ammonia-based solution, and then rubbing vigorously all the participants. He sprinkled a small sample of the poison in a protected corner of the hut, and then handed me a robust rooster and a jar of water, instructing me to pour a portion of the water down the bird's throat. Moments later he took the rooster, placed it on top of the poison and covered it with a hemp sack.
>
> "With the constant accompaniment of the sacred *asson*, or rattle, and the chants of the members of the secret society, the *houngan* sanctified my protection bottle. I named my intended victim, and he whispered it to the bottle. The *president* of the secret society, meanwhile, inverted a bottle of rum, causing it to bubble in a peculiar fashion, a certain sign that the poison would successfully complete my work. A match placed into the bottle exploded into flames and momentarily illuminated the entire enclosed temple.
>
> "The *madjaway* (see below) ground up pieces of *cadavre gaté* (an unidentified wood of the Capparidaceae) and mixed the dust with bits of a dried human cadavre and the shavings of a human tibia. The *president* pulled four feathers from the rooster's wing and instructed me to tie them in the shape of a cross as I asked them to bless my proposed work. At that point, Madame Jacques (my associate) accompanied the *madjaway* as he took the rooster to the sea in order to bathe its left foot. Upon their return to the temple, the *president* threw sulphur powder into a flame as he released the rooster to wander about the room. Placing seven drops of *clairin* (crude alcohol) and seven drops of rum into a bottle, the *president* began to mix the actual protection, adding sugar, basil leaves (*Ocimum Basilicum* L.), ground human bones, *cadavre gaté*, and

corn (*Zea Mays* L.). Then he rasped a human skull and added further bits of dried human flesh provided by the guardian of the cemetery. He then handed me three poisonous powders and gunpowder, instructing me to knead the powders into the wax before braiding the candles. When it came time to administer the poison, I was to light the candle and salute a sequence of stars before burying the candle beneath a path where I knew the intended victim would pass. To set the "trap" I had merely to sprinkle the poisonous powder in the form of a cross on the same spot, whilst repeating the victim's name. Each time I handled the poison, I was to drink from my protection bottle.

> "By this time, the *president* of the society was possessed by *Ogoun*, the spirit of fire and the metallurgic elements, and I was told that for complete protection I would have to be bathed by the rooster. The energy of the bird would thus pass to me, and by the end of the bath the rooster would be dead. As I stripped for the bath, I was instructed to drink from the protection bottle. Then the president, with wide strokes of the rooster, washed my entire body with an aromatic herbal solution. Indeed, by the end of the bath, the rooster lay on the ground, flaccid and quite dead."

While the protective magical potions guard the individual from the power of his own poison, they may also serve as antidotes to neutralize the effects of the poison on the actual victim. The ingredients and the preparations of these antidotes, however, are completely inconsistent from one locality to the next. For example, the antidote prepared at Saint Marc consisted of over thirty ingredients. The *houngan* began by placing in a mortar several handfuls of dried or fresh leaves of six plants, *aloe* (*Aloe Vera* L.), *gaiac* (*Guaiacum officinale* L.), *cedre* (*Cedrela odorata* L.), *bois ca-ca* (*Capparis cynophyllophora* L.), *bois chandelle* (*Amyris maritima* Jacq.) and *cadavre gaté* (cf. *Capparis* sp.). The plant material was ground with a quarter ounce of rock salt and then added to a basin containing ten crushed moth balls, a cup of seawater, several ounces of *clairin*, a bottle of perfume, and a quarter litre of a solution purchased from the local apothecary and known as *magie noire*, or black magic. Additional ingredients included ground human bones, shavings from a mule's tibia and from a dog's skull, various coloured and magically named samples of talc, ground match heads and sulphur powder. At Gonaïves, on the other hand, the antidote contained a handful of *bayahond* leaves (*Prosopsis juliflora* (Sw.) DC), three handfuls

of *ave* leaves (*Petiveria alliacea* L.), a litre of *clairin*, and ammonia and three magically prepared lemons. The antidote prepared near Leogane consisted solely of ammonia, *clairin*, and various aromatic solutions purchased at the local apothecary.

At all three localities, the initial treatment of the victim involves the topical application of the antidote as a vigorous massage. The antidote, nevertheless, is effective only during the two or three weeks immediately following exposure to the poison. After that time the *houngan* must resort to the standard Voudou curing ceremony or *expédition* that is used to exorcise any death spirit.

The victim is laid in a hole in the ground, his feet and head bound with white cloth and his body covered with a white sheet. A *pierre tonnerre* and the skulls of a human and a dog are placed on top of the sheet, whilst a sucker of a banana plant (*Musa paradisiaca* L.) is placed alongside the victim's body. Three calabashes of food representing three sacred Voudou concepts, the crossroads, the cemetery and the spirit of the forest (*Grans Bois*) are placed at the victim's head, on his abdomen and by his feet. The *houngan* then takes a live chicken and breaks each of its limbs to extract the death spirit from the corresponding limbs of the victim. The sacrifice of the chicken is complete when the *houngan* bites off the head. The victim then partakes of the sacrificial blood and is bathed with the antidote. Finally, as the victim lies in the ground, seven handfuls of earth taken from the crossroads, the cemetery and the forest and flung into the grave. The victim leaps up and the spirit flees into the banana plant. After a ritual bath with the blood of the sacrificed chicken and a restful night in the sanctity of the temple, the victim is well.

Hence, in considering both the composition of the various antidotes, and the way that they are administered, it appears that the ingredients are probably either chemically inert or else used in insufficient quantities to result in any pharmacological activity. In short, the recognized antidotes are but symbolic supports for what is essentially a magico-religious healing ceremony.

Though the antidotes are relatively uninteresting from a pharmacological point of view, the poisons themselves contain some of the most toxic organic substances known.

The poison collected in the environs of the town of Saint Marc was prepared in a deserted brook in the middle of desolate scrublands far from the nearest settlement. The *houngan*, as healer and representative of all that is benign, has no contact with the poison itself; this destructive force is processed by his *madjaway* who is considered neither an apprentice nor an assistant, but rather the physical support of the *houngan*. The first precept of the Voudou religion is that the temple, or *hounfor*, must never collapse, and the *houngan* is the personification of the temple. The word madjaway means literally "do not fall down". In Voudou ceremonies, it is often the *madjaway* who actually carries out the ritual task.

Though the *madjaway* prepares the poison, it is the presence of the *houngan* that assures the safety of the participants. He initiates the ritual songs and rubs the bodies of all present with protective salves. It is the *houngan* who covers the mouth and nose of each participant with the red cloth, the symbol of the *Petro* rites, the most powerful and violent of the Voudou faith.

The first step in the actual elaboration of the poison involves placing a live toad (*Bufo marinus* L.) in a closed container with any type of 'snake'. The *houngan* at Saint Marc preferred to use a species of polychaete worm, *Hermodice carunculata* Pallas. According to Voudou belief, this procedure increases the toxicity of the toad; in fact, the 'snake' does agitate the toad, increasing the amount of toxic secretions from the paratoidal glands. These secretions contain at least 26 highly active compounds, including: a) cardioactive steroids known commonly as bufogenins and bufotoxins; b) phenylethlamine bases and derivatives such as dopamine, adrenaline, noradrenaline; and c) tryptamine bases and derivatives such as serotonin, cinobufagin and bufotenin (Kennedy 1982). The polychaete worm has setae that inflict a paralyzing effect (Mullin 1923) and may be venomous (Halstead 1978).

The seaworm and toad are then killed and sun-dried with two innocuous looking marine fish, the *fou-fou* (*Diodon hystrix* L.) and the *crapaud de mer*, the sea toad (*Sphoeroides testudineus* L.). These two species belong to a large pantropical order of fish (*Tetraodontiformes*), many of which have the deadly nerve toxin,

tetrodotoxin, in their skin, liver, ovaries and intestines (Halstead 1978). Toxin levels within the species of *Diodon* vary, leading some investigators to believe that the fish serve as transvectors of the tetrodotoxin (Hashimoto 1979, Halstead 1978). Members of the genus *Sphoeroides* are known to be particularly virulent.

The four sun-dried ingredients are placed on hot coals, along with fresh specimens of two lizards, *Ameiva chrysolaema* Cope and *Leiocephalus schreibersi* Gravenhorst, and several pieces of human bone. Neither species of lizard is known to be toxic, but *Ameiva dorsalis*, a related species from Dominica, is said by natives to make the hair fall out and the skin turn green. Skinned and gutted, the lizard may be eaten but a Dominican folktale cautions, "if the ground lizard were good to eat, it would not be so common." A species in the related genus, *Cnemiedophotus*, the Florida bluetail, causes, when ingested, loss of balance in domestic cats (Lasell, pers. comm.).

All six animal ingredients are roasted to a soft oily consistency and then placed on a wooden mortar to be ground with the burnt human remains. At this stage in the preparation, 10 fruits of *Mucuna pruriens* (L.)DC, a leguminous liana known as the *pois gratter*, the itching pea, are placed in the mortar. The pods are armed with urticating hairs that cause a maddening itch: the seeds contain psychotomimetic constituents and may have hallucinogenic properties (Schultes and Hofmann 1973). Approximately 30 seeds of a second leguminous plant, *tcha-tcha, Albizzia Lebbeck* L., are likewise ground into the poison at this stage. Although the chemistry of this species is poorly known (Raffauf pers. comm.), it is of note that in West Africa, near the original homeland of the Haitian ancestors, the bark of a related species, *Albizzia zygia* is used in a drug known as *ibok usiak owo*. This potion serves as a truth serum, "a medicine for mentioning persons" and is probably administered as an ordeal poison (Forde 1956).

All the ingredients are pounded to a coarse consistency, and then sifted in a metal strainer to yield the final product.

The *houngan* at the locality near Gonaïves distinguished three stages or "degrees" to the preparation of the poison. During the first approximately 20 grams of ground centipeds of the orders

Spirobolida and Polydesmida and two entire tarantulas, *crabe araignée* (Theraphosidae) were mixed with four plant products: 30 seeds of *tcha-tcha* (*Albizzia Lebbeck*), 40 seeds of *consigne* (*Trichilia hirta* L.), and four handfuls of dried leaves each of *pomme cajou* (*Anacardium occidentale* L.) and *bresillet* (*Comocladia glabra* Spreng.), both species of the Anacardiaceae capable of causing severe dermititis. These ingredients wére ground together in the mortar, placed in a jar and buried. After two days, two plants which were not available for collection, known locally as *tremblador* and *desmembre*, were added to form the second degree. Five days later, the third degree was marked by the addition of another set of plants capable of causing surface irritations. Two were members of the Urticaceae, *maman guêpes* (*Urera baccifera* (L.) Gaud.) and *mashasha* (*Dalechampia scandens* L.). The others were *calmador, Dieffenbachia Sequine* (Jacq.) Schott., the common dumbcane which contains calcium oxalate crystals in its tissues, and *bois piné* (*Zanthoxylum martinicense* (Lam.) DC.) which is covered with sharp spines. Finally, the *madjaway* added approximately three grams of the seeds of the *concombre zombi*, the zombi's cucumber (*Datura Stramonium* L.) to the preparation.

The elaboration of the animal constituents was rather similar to the process documented at Saint Marc. The *bango* toad (*Bufo marinus*) was placed in a small box with a common non-venomous snake. It was then killed and sun-dried with the three species of puffer fish, the *bilan* (probably *Diodon holacanthus*), the *fou-fou* (*Diodon hystrix*) and the *crapaud de mer* (*Sphoeroides testudineus*). As at Saint Marc, these ingredients were placed on hot coals and broiled to an oily consistency. A novel additive at Gonaïves was the *crapaud blanc* (*Osteopilus dominicensis* Tschudi), a fresh specimen of which was placed directly on the hot coals along with several human bone fragments. The skin of this tree frog is covered by irritating glandular secretions (Lynn 1958) and a related species *Osteopilus septentrionalis* Dumeril & Bibron has been reported in Cuba to cause temporary blindness (Williams pers. comm.). At the third degree, the animal and plant products were combined, ground in the mortar and sifted to produce the final powder.

The poison prepared at Leogane consisted only of animal constituents. Once again, the *bilan* (cf. *Diodon holacanthus*) and a *crapaud de mer* (*Sphoeroides testudineus*) were sun-dried, broiled and placed in a mortar. Fresh specimens of two tarantulas (Theraphosidae) and three non-venomous lizards the *miti verde* (*Anolis coelestinus* Cope), the *zanolite* (*Anolis cybotes* Cope), and the *mabouya* (*Epicrates striatus* Fischer) were roasted on coals with two locally recognised varieties of *Osteopilus dominicensis*, the *crapaud blanc* and the *crapaud brun*. The *houngan* at Leogane especially emphasised the toxicity of human remains and included both ground human bones and dried pieces of human flesh in the preparation. The final product at Leogane was a coarse powder.

In all three documented preparations, the consistent ingredients are readily identified. The plant additives include species with urticating hairs, anacardiaceous plants that produce severe dermititis, an aroid with irritating calcium oxalate crystals and a number of species with spines. The addition of these irritants is related to the method of applying the poison. Though topically active, any one of the variations is said to be particularly effective if inhaled or applied to an open wound. In one preparation obtained at Saint Marc, ground glass was added to the mortar. Another informant suggested pricking the victim's skin with a thorn before applying the toxic powder. Several of the plants induce such acute irritation that the victim in scratching himself may cause open wounds. The poison may be applied more than once to the victim, and undoubtedly these self-inflicted wounds increase susceptability to subsequent doses.

There are two constant animal ingredients, ground human remains and one or more species in two genera of puffer fish: *Diodon hystrix, Diodon holacanthus* and *Sphoeroides testudineus*. In each preparation, the human remains are burnt almost to charcoal and probably are chemically inert. The puffer fish are merely broiled, and it is significant to note that neither frying, stewing, boiling or baking denature tetrodotoxins (Savtschenko 1882, Halstead and Bunker 1953). Tetrodotoxin is one of the most poisonous non-protein substances known: as an anesthetic, it is 160,000 times more potent that cocaine (Mosher 1964).

Furthermore it is topically active (Boye 1911, Phisalix 1922) and is capable of inducing physical states of simulated death characterised by immobility, peripheral paralysis and extremely low metabolic rates (Akashi 1880, Kimura 1927, Leber 1927, Fukada and Tani 1937, 1941, Fukada 1951, Halstead 1978, Davis 1983). It would seem, in closing, that, if zombification has a real pharmacological basis, the active constituent of the toxic preparation would undoubtedly be tetrodotoxin.

ACKNOWLEDGMENTS

This research was undertaken whilst I was supported by the Social Science and Humanities Research Council of Canada (Doctoral Fellowship). Direct financial support for all phases of the project was generously provided by the International Psychiatric Research Foundation. My botanical determinations were verified by Prof. Richard A. Howard of the Arnold Arboretum, Harvard University and the expert on the flora of the Caribbean. Zoological determinations were furnished by the staff of the Museum of Comparative Zoology, Harvard University. In particular I would like to thank Prof. Ernest Williams and Messrs. Greg Mayer, José Rosado, James Knight, Franklin Ross, Karsten Hartel and John Hunter. Complete sets of voucher specimens have been deposited at the M.C.Z. (animals) and (plants) at the Economic Herbarium of Oakes Ames in the Botanical Museum of Harvard University. I would especially like to thank Prof. Richard Evans Schultes for reviewing the manuscript, and Dr. Bruce Halstead for providing bibliographical material. The zombi project was born of the vision of three men: Mr. David Merrick, Prof. Heinz Lehmann, and the late Prof. Nathan S. Kline.

In Haiti I received essential logistical and intellectual assistance from a number of individuals. Dr. Lamarque Douyon shared his insights concerning medical aspects of zombification. In the Haitian countryside, I worked directly with several *houngan* who openly shared with me their remarkable knowledge. In particular I would like to thank Messrs. M. Pierre, Levoynt, J. Belfort, M. Bonnet, La Bonte and Madame Jacques. Finally I would like to

acknowledge my two colleagues M. Herard Simon and M. Max Beauvoir. Herard Simon and his wife Helen are *serviteurs* of the most profound awareness. One of the truly great traditional *houngan* of all of Haiti, Herard offered his spiritual and physical protection without which this project would never have been completed. Max Beauvoir, a man of grace and profound knowledge, was also directly responsible for the success of the project. He and his wife Elizabeth offered me their home, and provided emotional, intellectual and physical support at the most critical moments. His daughter Rachel worked with me on every phase of the fieldwork. She showed herself to be a courageous fieldworker, an insightful anthropologist and a wonderful companion.

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THE PHYTOCHEMISTRY OF *QUARARIBEA FUNEBRIS*[1]

ROBERT F. RAFFAUF[2] AND THOMAS M. ZENNIE[3]

In an earlier issue of the *Botanical Museum Leaflets*, the ethnobotany of *Quararibea funebris* (La Llave) Vischer (Bombacaceae) was reviewed. The flowers have been used since pre-Columbian times by the Zapotec Indians of Oaxaca, Mexico as an additive to chocolate drinks and medicinally as an antipyretic, a cough remedy, to control "psychopathic fear" and to regulate the menses (Rosengarten, 1977). There is also some evidence to suggest that they may have been used as an hallucinogen (Wasson, 1982). Other than Rosengarten's report of the presence of alkaloids in these flowers, the chemistry of the genus has not been studied.

In the hands of the phytochemist, the family has not fared much better. Mucilages (Gibbs, 1974), the carbohydrates raffinose and stachyose (Gibbs, 1974; Hegnauer, 1964) and the cyclopropenoid fatty acids obtained from the seed oils have been reported (Bohannen, 1978; Morris and Hall, 1967). In addition to the economically important members of the family (*Ceiba pentandra*, kapok; *Ochroma* spp., balsa wood), the fruits of several genera have been used as food:The durian *Durio zebethinus* Murr. is a very odorous fruit and is claimed to have great rejuvenating powers (Hutchinson, 1967); the young fruits and roasted seeds of *Ceiba aesculifolia* (HBK.) Britt. and Baker, the seeds of *Pachira macrocarpa* (Schlecht. and Cham.) Walp. (Standley,

[1]This paper is dedicated to my friend and colleague in Natural Products Chemistry of many years, Dr. Ulrich Weiss, National Institutes of Health, in commemoration of his 75th birthday.

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1930) and the fruits of *Quararibea cordata* (H.&B.) García-Barriga and Hernandez are eaten (Hodge, 1960). A decoction of the bark and flowers of *Bombax ellipticum* HBK. is employed as a cough remedy, and the nectar of the flowers is applied to the eyes to relieve inflammation (Standley, 1930). The small stems and twigs of *Q. turbinata* (Schwartz.) Poiret are used in many parts of the West Indies and Central America as frothing sticks called "molinillos," and in some areas it and other species of Quararibea are known as "swizzle stick trees". It is not unlikely that the mucilages present in members of the family account for this use as well as the use as a cough remedy.

The Bombacaceae comprise 31 genera and 225 species distributed among six tribes (Hutchinson, 1967). Quararibea is found in the tribe Matisieae along with seven other genera, including Matisia. The latter genus was considered at one time to be synonymous with Quararibea by some authors (Fisher, 1919; García-Barriga, 1959; Alverson, 1982); but, because of flower morphology, the two are considered by others as separate genera (Schultes, 1957). A possible chemotaxonomic distinction lies in the peculiar odor of all parts of the plants of the genus Quararibea, the flowers being particularly odorous. The odor can be described as a cross between vanilla and linden flowers; some compare it to the odor of slippery elm bark (Standley, 1930) or fenugreek (Record, 1939). However it may be described, it is completely absent in Matisia and thus represents a distinction between the two genera. The genus Quararibea contains 29 species, all of which have this odor: It is so persistent that a specimen collected in 1841 was found still to possess this noticeable aromatic character (Schultes, 1957).

There were, then, several reasons to undertake the complete phytochemical investigation of the flowers of *Quararibea funebris* which is summarized here; experimental details will be published elsewhere.

The milled flowers were extracted first with hexane, then with 95% ethanol. Traditional solvent partition and chromatographic methods were used to separate these extracts into several fractions which were examined individually. The neutral hexane-soluble constituents were unremarkable: a mixture of waxy

hydrocarbons (predominantly C_{25}, C_{27} and C_{29} alkanes), the ethyl esters of linoleic and linolenic acids, and a mixture of C_{29}-C_{31} sterols (chiefly β-sitosterol) esterified with C_{16} and C_{18} fatty acids were obtained. A neutral chloroform fraction yielded, in addition to small amounts of the above compounds, some free fatty acids and the glucosides and glucoside palmitic/oleic acid esters of β-sitosterol and stigmasterol—all known compounds.

It was in the alcohol extract that the interesting chemistry of the plant was revealed. Concentration, partition between aqueous and organic phases at selected pH values, followed by chromatographic separation and crystallization, yielded several compounds. The odor principle was identified as 3-hydroxy-4,5-dimethyl-2(5H)-furanone (IV): the first report of this compound in a plant. It had been recognized previously as a constituent of aged sake formed during the aging process rather than as a constituent of sake itself (Takahashi, 1976); and as a constituent of sugar cane molasses (Tokimoto, 1980). It had been synthesized even earlier in a study of food flavorings (Sulser, 1972) and was found to have one of the lowest threshold values known for food flavoring compounds, perceivable in concentrations as low as 0.01 ppb. It is also attractive to cockroaches, houseflies and ants, and has been described as having the flavor of walnuts. A structurally similar ketone, 2,5-dimethyl-4-hydroxy-3(2H)-furanone, has been reported from pineapple, contributing a "burnt pineapple" note to the overall flavor of the fruit (Rodin, 1965).

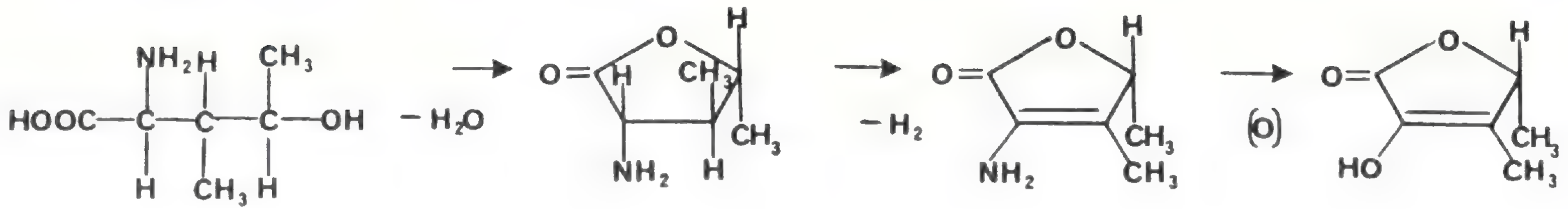
Two closely related aminolactones, 3-amino-4,5-dimethyl-2(5H)-furanone (III) and its saturated analog (II) were also isolated from the flowers and, to our knowledge, are likewise new to the plant kingdom. The presence in *Q. funebris* of these lactones is of more than passing interest in view of a recent publication on the anticonvulsant activity and potential clinical usefulness of a group of alkyl-substituted butyrolactones (Klunk, 1982) structurally related to them. It is not unlikely that some of the folk-medical use of the flowers is referable to these compounds. Further, the hypothermic and behavioral effects reported for γ-hydroxybutyric acid itself (Snead, 1978) suggest that the utilization of *Q. funebris* preparations as antipyretics and possibly as an hallucinogen may not be at all unreasonable. Pharmacological

studies designed to test these hypotheses are planned. Also present, albeit in very small amounts, was an alkaloid of a new structural type which we had named "funebrine" (V) and which represents the first alkaloid to be recorded in the Bombacaceae. It was accompanied by at least two other polar alkaloidal compounds in quantities too small to permit characterization at the present time.

Finally, the isolation of a novel amino acid, 2S,3S,4R-4-hydroxyisoleucine (I) in substantial amounts allowed us to propose a biogenetic scheme for the synthesis by the plant of the above compounds as shown in the accompanying figure. The novelty of this amino acid lies in the fact that it appears to be a diasteriomer new in nature; its epimer, 2S,3R,4R-4-hydroxyisoleucine, had been isolated from fenugreek seed (Fowden, 1973) and was found to be a component of α-amanitin (Wieland, 1968). The fact that I could be converted readily to II was of obvious help in defining the geometry of the other compounds in the series.

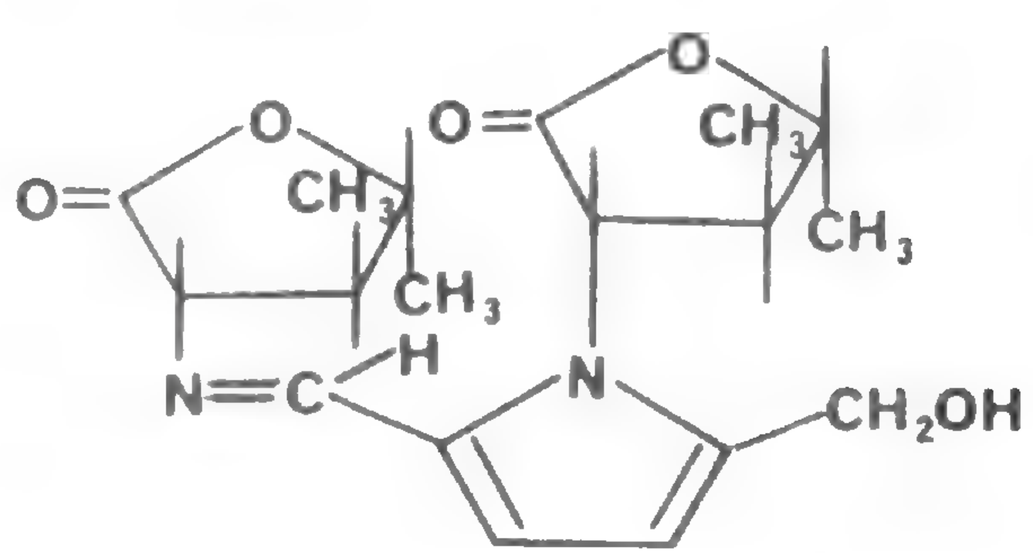
Among the non-nitrogenous constituents of the remaining aqueous fractions of the ethanolic extract were rather large quantities of glucose, fructose and sucrose. This leads to the suggestion that the flowers served the additional purpose of sweenening the Zapotec chocolate drinks, inasmuch as sugar cane was not known in the New World until after the Conquest. A small amount of a complex mixture of flavonoids was also present, but no individual compounds were identified.

During the course of the study, a small sample of *Quararibea turbinata* leaves became available to us. The chemical profile of these was very similar to that of the *Q. funebris* flowers; compounds I, II and III were identified, the presence of alkaloids was established and compound IV, though not yet isolated and identified, is suspected to be present by reason of the familiar odor of the extracts. We have recently acquired several other species of the *Quararibea/Matisia* complex and will be interested to learn whether any one or all of these compounds will serve to distinguish the genera in this portion of the Bombacaceae of whether, indeed, they are characteristic of the family.



I II III IV

Glucose (?)



V

FUNEBRINE

In any event, virtually all of the substances isolated and characterized in this study are new to the genus *Quararibea* and to the Bombacaceae, and some of them are new to the plant kingdom itself. Inasmuch as the γ-butyrolactones can act as convulsants and anticonvulsants, and since *Q. funebris* flowers are used medicinally as a sort of anti-anxiety folk remedy—a common side effect of all anticonsulvant drugs is sedation— it seems reasonable to suggest that the lactones isolated in this study may act in a similar way, corroborating once again the wisdom of the early meso-American peoples in their use of biodynamic plants.

We are indebted to Dr. R. Gordon Wasson and Prof. Richard Evans Schultes for making available bulk samples of the flowers of *Quararibea funebris*: representative material of both collections have been deposited as voucher specimens in the Botanical Museum of Harvard University. Dr. José Luis Vivaldi, Department of Natural Resources, Commonwealth of Puerto Rico, has helped us in collecting and identifying the leaves of *Q. turbinata*. To Dr. Schultes we are grateful for his sustained interest in our research.

The voucher specimen on which the final chemical studies were made consisted of dried flowers purchased in the marketplace in Oaxaca, Mexico. Samples have been deposited in the Economic Products Collection in the Botanical Museum of Harvard University. The material was collected by *R.E. Schultes s.n.* in August, 1981.

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PLATE 19

QUARARIBEA
funebris (Llave) Vischer

E. W. Smith

BOTANICAL MUSEUM LEAFLETS
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THE ETHNOBOTANY OF THE WAORANI OF EASTERN ECUADOR

E. WADE DAVIS AND JAMES A. YOST*

Because of their intimate knowledge of plants, indigenous peoples of the Amazon have long had an essential role in the scientific search for new natural products. Today, with the tropical rain forest being destroyed at an alarming rate, and with the indigenous groups themselves facing acculturation or extinction, the modern world stands to lose a wealth of knowledge of unknown potential. The need for thorough ethnobotanical surveys is urgent. This paper presents the results of such a basic study conducted among the Waorani, one of the most recently contacted and vulnerable indigenous groups in South America.

The Waorani are a small group of 660 Indians whose traditional homeland covers some 8000 square miles of tropical wet forest south of the Rio Napo and north of the Rio Curaray between 76° W and 77° 30′W in eastern Ecuador. Generations of hostility between the Waorani and all outside groups have maintained these borders. The Waorani refer to outsiders as *cowode*

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and traditionally considered them cannibals, while most Ecuadorians know the Waorani as "*Auca*", a Quichua word meaning "savage." Mutual fear and contempt persisted for years and was characterized by killings on both sides, the most famous of which was the "Palm Beach Massacre" of five missionaries in 1956 (*New York Times*, Jan. 13, 1956). The first sustained peaceful contact did not occur until 1958 (Yost 1981b, Wallis, 1973). Ethnohistorical and linguistic data indicate that the Waorani have been isolated from even surrounding indigenous groups for many generations. To date, no linguistic congeners have been found and at the time of contact only two loan words could be identified in the Waorani language (Peeke, 1973).

Waorani social structure and settlement pattern contributed to their protracted isolation. Acephalous and highly egalitarian, Waorani political and social life are based on the kindred, a complex network of extended kin ties. The traditional Waorani settlement consisted usually of one or two long houses occupied by an extended family spanning three to four generations. Frequently, several other similar settlements closely related to the first settlement would be located within a half hour walk; this "neighborhood cluster" of several related settlements composed the community with which an individual identified throughout his life. Half a dozen such neighborhood clusters were distributed over a vast tract of rain forest isolated from one another by distance and fear. Never certain of exactly where the other communities were, the Waorani simply designated them as "upriver Waorani", "downriver Waorani," or "overland Waorani". This isolation within the territory reinforced a deep suspicion and hostility among the various Waorani groups, thereby functioning as both cause and effect of considerable intra-tribal warfare. Spearing raids were a constant feature of Waorani life and accounted for an astonishing 54% of male and 39% of female mortality. The perpetual blood feuds made the Waorani particularly adept in the forest; in the aftermath of the spearing raids, individuals were frequently forced to subsist for weeks on raw forest products alone.

Internal threats, however, were not the sole source influencing Waorani behavior and their dependence on the forest. The fear of

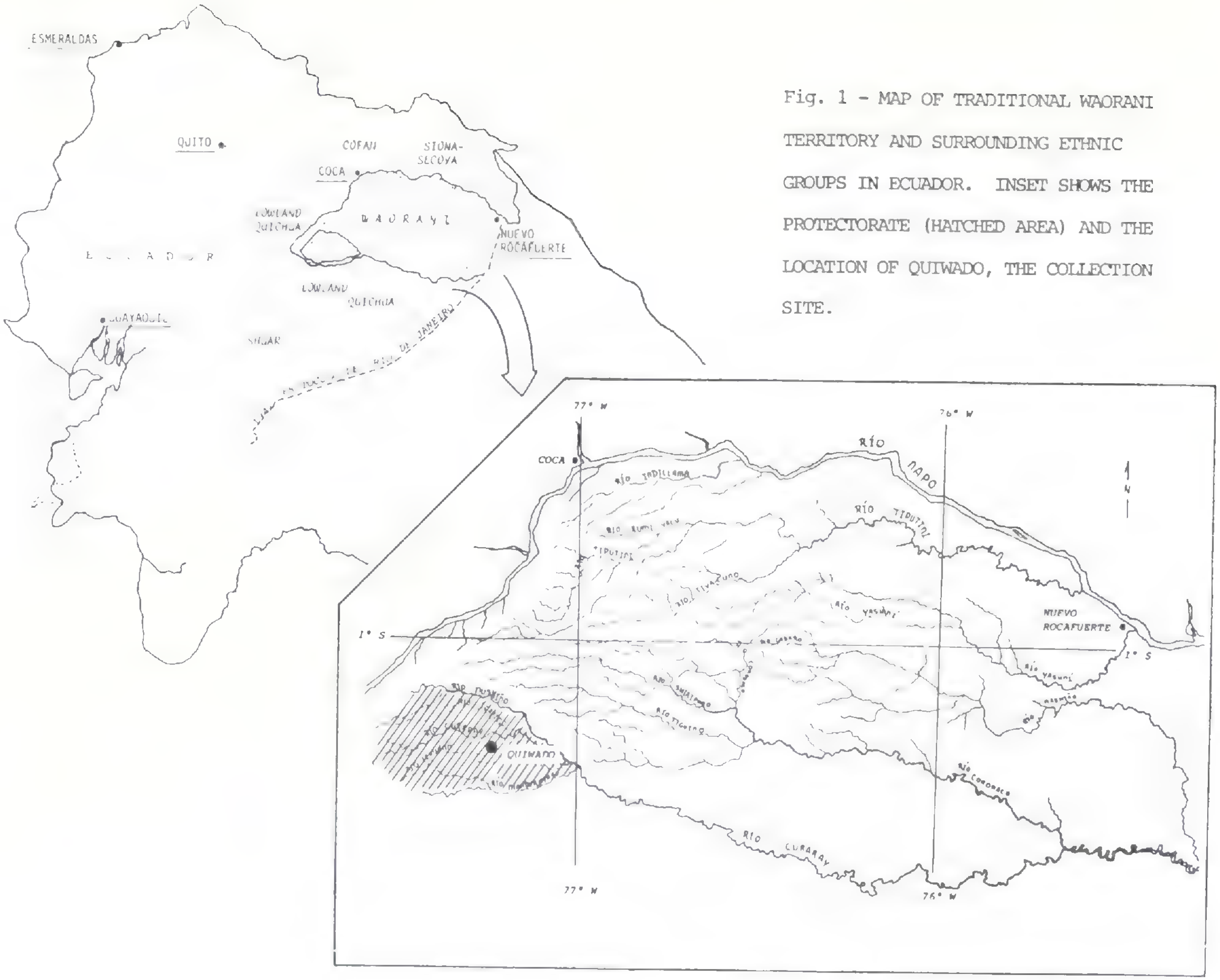

Fig. 1 - MAP OF TRADITIONAL WAORANI TERRITORY AND SURROUNDING ETHNIC GROUPS IN ECUADOR. INSET SHOWS THE PROTECTORATE (HATCHED AREA) AND THE LOCATION OF QUIWADO, THE COLLECTION SITE.

outsiders, or *cowode*, was a significant factor influencing the Waorani to settle on hillsides in the hinterland and deliberately to avoid all major rivers, which they considered the domain of *cowode*, such as the surrounding Lowland Quichua. As a result, the Waorani did not swim or use canoes, and their fishing was limited to the small feeder streams of the interfluvial forest. They considered the common Amazonian sources of protein, such as large catfish, water fowl and turtle eggs, to be taboo, and ate only a few of the fifty or more species of fish and numerous aquatic animals available to them. Although they maintain garden plots and derived a considerable amount of their carbohydrate intake from them, there is some evidence that agriculture came late (Yost, 1981a). Today, the Waorani still consider themselves people of the forest and derive most of their protein and virtually all of their minerals and vitamins from it.

Given the Waorani identification with the forest, both psychologically and cosmologically, and given their dependence upon the forest for much of their diet, it is not surprising that the Waorani are exceptionally skilled ecologists. The sophistication of their interpretation of biological relationships is demonstrated in their recognition and understanding of such conceptually complex phenomena as pollination and dispersal and in their understanding of the interdependence of animal and plant cycles, which enables them accurately to predict animal behavior. They anticipate the flowering and fruiting cycles of edible forest plants and know not only what species most forest animals prefer to feed on, but what part of the plant and in what stage of development they prefer it.

This intimate knowledge of the forest ecology, together with their long isolation as a people, make the Waorani an ideal group for ethnobotanical investigation. Based on interviews with the Waorani and on nine years of experience with them, we estimate that we have collected approximately 80% of the plants known to be used by the Waorani. Our data show a surprising dearth of medicinal plants (cf. Davis and Yost, in press), a peculiar use of hallucinogens and a particularly high utilization of wild foods.

Biomedical studies done at the time of contact or shortly thereafter describe a remarkably healthy people with very minimal problems with epidemic disease, internal parasites or bacterial

infections (Larrick *et al.* 1979; Kaplan *et al.* 1980). The Waorani were afflicted by external parasites, fungal infections, poor dentition and undefined fevers as well as one of the highest rates of snakebite in the world (Theakston *et al.* 1981; Larrick Larrick *et al.* 1978). For each of these conditions, the Waorani had herbal remedies, but it is particularly noteworthy that almost the entire Waorani pharmacopoeia treats only the few endemic afflictions readily identified by extensive biomedical studies. Only 35 of the plants that we collected are used medicinally, and, of these, 30 are employed to treat no more than six conditions: fungal infections, snakebite, dental problems, fevers, tropical warble fly larvae (*Dermatobius hominus*), and various stings. By comparison, Pinkley collected 57 medicinal plants from the neighboring Cofán, and those plants were used to treat 27 different ailments (Pinkley 1973). We have discussed this highly specialized use of medicinal plants and the theoretical implications of Waorani ethnomedical practices elsewhere (Davis and Yost, in press).

Throughout the northwest Amazon, hallucinogenic plants are an important feature of religious life. The Waorani use hallucinogens, but the species employed and the associated ritual are peculiar. The Waorani have two hallucinogens, *Banisteriopsis muricata* (Cav.) Cuatracasas and an as yet undescribed basidiolichen of the genus *Dictyonema*. The former is morphologically very similar to other commonly used psychoactive species such as ayahuasca, *Banisteriopsis Caapi* (Spr. ex Griseb.) Morton, but it has never been studied pharmacologically (García-Barriga, 1975). On the other hand, no basidiolichen has yet been reported as an hallucinogen. According to some Waorani, an infusion prepared from the lichen and various mosses caused severe headaches and confusion when ingested and was used by a shaman to send a curse on a person to kill him or her. In comparison with the practices of other Amazonian tribes the Waorani use of hallucinogens is clearly anomolous. While others imbibe hallucinogens to fulfill the collective needs of the group, the Waorani intoxication may be characterised as aggressive, anti-social and highly individualistic (Davis and Yost, in press).

A final point worth noting concerning Waorani ethnobotany is the extensive use of wild food plants. After a year among the Kofan, Pinkley reported 24 wild foods and 25 cultivated or semi-

cultivated dooryard plants, a number of which were commonly introduced species that the Waorani do not grow (Pickley, 1973). The Waorani specimens include no fewer than 44 regularly eaten wild foods and only 19 cultivated or semi-cultivated plants.

In the following compilation, the families of vascular plants are arranged according to the Engler and Prantl system; and the genera are arranged alphabetically under the families. The lower plants are in alphabetical order by family. Complete sets of voucher specimens have been deposited at the Economic Herbarium of Oakes Ames of Harvard University and the herbarium of the Universidad Católica, Quito, Ecuador. All collections were made by Davis and Yost in the environs of the clearing of Quiwdo, near the confluence of the Rios Quawado and Tiwaeno (77°14'W, 1°50'S) in eastern Ecuador. The collection numbers are those of E.W. Davis.

To aid future investigators, our collecting assistants have been identified by name, sex and sub-dialect. In some instances, once a plant was collected, a variety of informants, representing all of the three major subdialects, were interviewed to verify the plant's use. As an aid to approximating pronunciation of the vernacular names, we have used a modified phonemic orthography easily followed by the non-linguist. Consonants are pronounced as in Spanish. Vowels are pronounced as follows: "a" pronounced as in English f*a*ther, "¢" as in c*a*t, "i" as in m*ea*t, "e" as in p*i*n or h*i*t, "o"" as in h*o*pe, sh*oe* or p*u*t, and "ng" as in si*ng* or ha*ng*er. If a vowel be written twice in succession, it is held for a longer duration. Vowels contiguous to nasal consonants are nasalized. Other vowels may be nasalized as well, but they are not so marked here. For a complete description see Peeke (1973).

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TABLE 1

List of Waorani Useful Plants

PLANTS USED AS TECHNOLOGY

Bambusa sp.	Gramineae	Ooña
Setaria vulpiseta	Gramineae	Gage
Undetermined	Gramineae	Yęmingo
Astrocaryum Chambira	Palmae	Oopogęncawę

Bactris sp.	Palmae	Iica
Bactris Gasipaes	Palmae	Tewe
Geonoma sp.	Palmae	Mo
Geonoma sp.	Palmae	Tedeñowencabo
Geonoma sp.	Palmae	Oomawe
Jessenia Bataua	Palmae	Petowe
Maximiliana Maripa	Palmae	Oompa
Socratea exorrhiza	Palmae	Yedemo
Wettinia guinaria	Palmae	Cayewebewe
Undetermined	Palmae	Tepa
Undetermined	Palmae	Giyicabemo
Undetermined	Palmae	Omacabo
Cyclanthus sp.	Cyclanthaceae	Wino
Heteropsis sp.	Araceae	Otome
Calathea Standieyi	Maranthaceae	Oyoncabo
Ischnosiphon obliquus	Maranthaceae	Gayaquewencagi
Selenipedium sp.	Orchidaceae	Meñegagowe
Ficus maxima	Moraceae	Corotamo
Minquartia guianensis	Bignoniaceae	Cobacadewe
Perebea guianensis	Moraceae	Bataca
Curarea tecunarum	Menispermaceae	Oonta
Enterolobium sp.	Leguminosae	Compago
Lonchocarpus Nicou var. Urucu	Leguminosae	Meneco
Undetermined	Leguminosae	Acowe
Picramnia Spruceana	Simaroubaceae	Degintai gipenii
Picramnia sp.	Simaroubaceae	Degintai gipenii
Gossypium barbadense	Malvaceae	Dayo
Ceiba pentandra	Bombacaceae	Bobewe
Souroubea sp.	Marcgraviaceae	Oonta
Vismia sp.	Guttiferae	Gacamenewe
Tovomita sp.	Guttiferae	Gingamonca
Bixa Orellana	Bixaceae	Caca
Carpotroche longifolia	Flacourticea	Nonginca
Calyptranthes plicata	Myrtaceae	Cowadewe
Clavija sp.	Theophrastaceae	Namontaqui
Brunfelsia grandiflora ssp. Schultesii	Solanaceae	Wiñemecawe
Crescentia Cujete	Bignoniaceae	Owewe
Ruellia colerata	Acanthaceae	Ewemoya
Alibertia cf. edulis	Rubiaceae	Owecawe
Simira sp.	Rubiaceae	Wepeta
Clibadium asperum	Compositae	Cooñei
Minquartia guianensis	Olacaceae	Cobacadewe
Undetermined		Anawenta
Undetermined		Omeogo
Undetermined		Winca

Cultivated Plants

Zea Mays	Graminae	Cagingo
Dioscorea trifida	Dioscoreaceae	Cowango
Musa paradisiaca	Musaceae	Peene
Arachis hypogaea	Leguminosae	Coromo
Lonchocarpus Nicou var. languidus	Leguminosae	Compago
Pachyrhizus angulatus	Leguminosae	Capamo
Manihot escuelenta	Euphorbiaceae	Ouewe
Gossypium barbadense	Malvaceae	Dayo
Bixa Orellana	Bixaceae	Caca
Carica Papaya	Caricaeae	Awanca
Ipoemoea Batatas	Convolvulaceae	Acage
Capsicum chinense	Solanaceae	Giimo
Capsicum sp.	Solanaceae	Giimo
Physalis angulata	Solanaceae	Cowañe moncamo
Solanum sessiliflorum	Solanaceae	Daboca
Crescentia Cujete	Bignoniaceae	Owewe
Clibadium asperum	Compositae	Cooñei

Wild Foods

Auricularia fuscosuccinea	Auriculariaceae	Nenendape
Astrocaryum Chambira	Palmae	Oopogencawe
Bactris sp.	Palmae	Iica
Bactris Gasipaes	Palmae	Tewe
Jessenia? Bataua	Palmae	Petowe
Maximiliana Maripa	Palmae	Oompa
Socratea exorrhiza	Palmae	Yedemo
Phytelephas macrocarpa	Palmae	Wamowe
Undetermined	Palmae	Omacabo
Heteropsis sp.	Araceae	Otome
Costus erythrocoryne	Zingiberaceae	Gonequemo
Costus scaber	Zingiberaceae	Odengimoncagi
Dimerocostus strobilaceus ssp. strobilaceus	Zingiberaceae	Ñenenquemo
Cecropia sciadophylla	Moraceae	Mangimeo
Dialium guianensis	Leguminosae	Dicademo
Inga sp.	Leguminosae	Iwa ao
Inga sp.	Leguminosae	Ewemao, wenemengo
Protium sp.	Burseraceae	Wingitage
Hiraea sp. nov.	Malpighiaceae	Dowemeñei
Tapura amazonica	Dichapetalaceae	Awencatomo
Herrania nitida	Sterculiaceae	Bognica
Theobroma sp.	Sterculiaceae	Meẽeca,
Undetermined	Sterculiaceae	Bogiwe
Marcgravia sp.	Marcgraviaceae	Namontaque

WILD FOODS cont'd.

Rheedia Spruceana	Guttiferae	Contaca
Leonia glycycarpa	Violaceae	Yemenca
Casearis sp. fasciculata	Flacourtiaceae	Yepenemoncawe
Casearia prunifolia	Flacourtiaceae	Yepenemoncawe
Mayna odorata	Flacourtiaceae	Bogimoncamo
Begonia sp.	Begoniaceae	Omencai
Gustavia longifolia	Lecythidaceae	Nonginca
Grias Neuberthii	Lecythidaceae	Wingaca
Calyptranthes plicata	Myrtaceae	Cowadewe
Loreya collatata	Melastomataceae	Titemeñeca
Undetermined	Melastomataceae	Ewengu
Undetermined	Sapotaceae	Oopowe
Undetermined	Apocynaceae	Wepemonca
Solanum pectinatum	Solanaceae	Daboca
Coussarea brevicaulis	Rubiaceae	Omancomo
Pentagonia parvifolia	Rubiaceae	Boyomo
Cayaponia Ruizii	Cucurbitaceae	Cagiwenca
Undetermined		Contaca
Undetermined		Titequewe
Undetermined		Tañemo

HALLUCINOGENS

Dictyonema sp. nov.	Dictyonemataceae	Nenendape
Banisteriopsis muricata	Malpighiaceae	Mii
Bryophyta misc. genera		Kigiwai

MEDICINES

Plants used for fungal infections and/or scabies and mite infestations

Iryanthera cf. elliptica	Myristicaceae	Awamoncawe
Iryanthera juruensis	Myristicaceae	Wingimoncawe
Iryanthera cf. paraensis	Myristicaceae	Wecaiwe
Otoba parvifolia	Myristicaceae	Ayepewe
Virola calophylla	Myristicaceae	Tegidewe
Enterolobium sp.	Leguminosae	Cenimowe
Undetermined	Leguminosae	Acowe
Calycophyllum acreanum	Rubiaceae	Ooyowe
Curarea tecunarum	Menispermaceae	Oonta
Undetermined		Dabetawe

Plants used for warble fly (Dermatobius hominus)

Undetermined	Araceae	Cowentobecagi
Hevea guianensis	Euphorbiaceae	Noogowe
Undetermined	Apocynaceae	Ceneiwe

Plants used for tooth decay

Sphaeropteris sp.	Cyathaceae	Toyoba
Piper augustum	Piperaceae	Nempocao

Piper conejosense	Piperaceae	Yacabe
Undetermined		Menetade
Plants used for various stings and bites—Scorpion, Spider, Insect, Stingray		
Solanum pectinatum	Solanaceae	Daboca
Solanum sessiliflorum	Solanaceae	Daboca
Pentagonia spathicalyx	Rubiaceae	Boyomo
Plants used for Snakebite		
Philodendron sp.	Araceae	Cayatamo
Renealmia Asplundii	Zingiberaceae	Teetemo
Renealmia thyrsoidea	Zingiberaceae	Teentecagi
Renealmia sp.	Zingiberaceae	Teentebo
Urera baccifera	Urticaceae	Wento
All Other Medicinal Plants		
Jessenia Bataua	Palmae	Petowe
Maximiliana aff. maripa	Palmae	Oompa
Urera baccifera	Urticaceae	Wento
Guatteria cf. Schunkeyigoi	Annonaceae	Meñedowe
Siparuna sp.	Monimiaceae	Nonangonca
Begonia sp.	Begoniaceae	Omencai
Capsicum chinense	Solanaceae	Giimo
Capsicum sp.	Solanaceae	Giimo
Mansoa Standleyi	Bignoniaceae	Wiyagei
Duroia hirsuta	Rubiaceae	Owecawe

Auriculariaceae

Auricularia cf. **fuscosuccinea** (Montague) Farl., *Bibliogr. Index* (1905) 307.
Collect.: Davis and Yost 932.
Waorani Informant: Geque (m). Downriver dialect: n.v. *nɛ́nɛ́ndapɛ́*

This gelatinous fungus grows commonly on fallen logs in the forest and in the open swidden agricultural clearings. Today, some Waorani roast the fungus over an open fire and eat it with salt, a practice that they have learned in recent years from the neighboring Quichua.

Many indigenous groups in the Amazon eat this fungus. The Bora of the Rio Ampiyacu in Peru boil the fungus and eat it with cassava (*Manihot escuelenta*) and hot sauce (*Capsicum* sp.).

Dictyonemataceae

Dictoyonema sp.
Collect.: Davis and Yost 1051.
Waorani Informant: Tomo & Cento (m). Upriver dialect: n.v. *nẹnẹndapẹ*

This conspicuous genus of a lichenized basidiomycete is extremely rare in Waorani territory. What has been considered a new species by a leading lichenologist, this peculiar plant, growing on rotten wood, has a white hymenial layer and a bright green/blue upper surface (M. Hale pers. comm.).

The Waorani name *nẹnẹndapẹ* is a name applied to many fungi, but informants suggest that this one was once used in shamanistic ritual. It was last employed some four generations ago—approximately 80 years — when "bad shamans ate it to send a curse to cause other Waorani to die." The drug was prepared as an infusion with various species of Bryophyta, and caused severe headaches and confusion when drunk. When adequate supplies are available, this plant should be tested for hallucinogenic properties. This is the first report of a potentially hallucinogenic basidiolichen.

It is also reported to cause sterility and to be put into a child's drink to cause barrenness. At the moment, it is unclear whether this is a *post-hoc* explanation of why some women are sterile or whether it indicates active chemical constituents. Although no peculiar lichen acids have been reported, the genus is very poorly known and warrants phytochemical investigation.

Cyathaceae

Sphaeropteris sp.
Collect.: Davis and Yost 964.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *toyoba*

This species, a common tree fern that attains a height of four meters in the primary forest, is used to soothe toothache. The Waorani collect the sap and keep it for a day until it oxidizes and thickens; they then apply it directly to exposed nerves as an anesthetic.

Bambusa sp.
Collect.: Davis & Yost 1027.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *oona*

This bamboo grows to a height of ten meters both on low river flats and the slopes of steep clay hills. The internode length makes it ideal for dart holders and flutes. Pieces of the stem provide improvised knives.

Setaria vulpiseta (Lam.) R. et S., Syst. 2 (1817) 495.
Collect.: Davis & Yost 947.
Waorani Informant: Geque (m). Downriver dialect: n.v. *gage*

This common grass grows to a height of 2.5 meters in open sunlight around clearings and house sites. The inflorescence serves as a paint brush to decorate the body with *winca* (possibly *Genipa* sp.) and *caca* (*Bixa Orellana*).

Zea Mays L., Sp. Pl. (1753) 971.
Collect.: Davis & Yost s.n.
n.v. *cagingo*

Maize, although a relatively minor food crop of the Waorani, is important because it is the first cultigen to be ready to harvest in a new garden. Informants from the more isolated regions claim that in past generations maize held a far more significant role than any other food crop, but this changed when plantains became successful.

Undetermined specimen of Gramineae
Collect.: Davis & Yost 946.
Waorani Informant: Geque (m). Downriver dialect: n.v. *yémingo*

This unidentified bambusoid grass grows commonly in the primary rain forest. The flowers are conspicuous with dangling bright yellow anthers.

The Waorani carefully split the new shoots vertically and use the exposed edges as a knife to cut the umbilical cord of a newborn infant or as an improvised knife to butcher an animal killed in the forest.

Astrocaryum Chambira Burret in Fedde, Repert. 35. (1934) 152.
Collect.: Davis & Yost 978.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *oopo-gɇncawɇ*

A common tree of the primary rain forest, the chambira palm is a plant that the Waorani rely on heavily for a variety of uses. Both the immature and mature fruits are eaten, and the apical leaf shoots provide an important fibre which is rolled into twine for hammocks, fishnets, carrying bags and necklaces. Since the Waorani often cut down mature trees to gather the fibre, and since a single large hammock may require as many as twenty trees, this tree is one of the resources that may become scarce if a village remains in one area for a long time.

The Waorani have various names for the chambira palm, depending upon its stage of development. Seedlings are called *oonɇoncagi*, saplings from 2-7 meters are *oonɇmpa* and, once the trunk emerges, the plant receives its mature name *oopogɇcawɇ*.

Although the Waorani do not recognize any medicinal properties in *Astrocaryum Chambira*, certain other species of *Astrocaryum* are used medicinally elsewhere. *Astrocaryum Ayri* Mart. has a "green fruit that holds 10 grams of a potable liquid which has medicinal properties. It is used as a laxative and against jaundice. When the fruit is ripe, the liquid is transformed into a fleshy mass which contains 18% of the oil known as *oleo de ayry*. When the substance is dried, it is reputedly used as a "taenifuge" (Pio Correa 1926).

In Brazil, the fruits of *A. Chambira* are used to treat erysipelas (Usher 1974), and the fruit pulp is said to be antihelminthic (Pereira 1929).

Bactris sp.
Collect.: Davis & Yost 977.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *iica*

A common forest tree that grows to 10 meters high, this species has long leaves with extremely thorny leaf bases. The leaves are commonly used for thatch, and the fruit is eaten.

Although the Waorani do not use this plant medicinally, various species of *Bactris* are said to have medicinal properties. In Colombia, the fruits of *Bactris minor* Jacq. are employed in a decoction as an antihelminthic and laxative. They are also used to treat snakebite (Garcia-Barriga 1974). In Guyana, a decoction of the heart of *Bactris oligoclada* Burret is valued in treating bronchitis (Fanshawe 1950).

Bactris Gasipaes HBK., Nov. Gen. et Sp. 1 (1815) 302.
Collect.: Davis & Yost s.n.
n.v. *tewɇ*

Such is the importance of this semi-cultivated palm that the Waorani "new year" (*dagɇnca tedɇ*) is marked by the end of its fruiting cycle. "Chonta" season runs from November to April and is divided into six periods: blossoms falling down; fruits starting to form; fruits starting to ripen; fruits all ripe; fruits nearly gone; fruits all gone.

While the fruits (*dagɇnca*) provide an important source of carbohydrate and vitamins, the extremely hard wood (*tepa*) is used to make spears, blowguns and various utensils. Because of its durability, it is also a favorite source material for roof supports and other construction purposes.

Geonoma sp.
Collect.: Davis & Yost s.n.
Waorani Informant: Geque (m). Downriver dialect: n.v. *mo*

This low palm grows 1.2 meters tall in the primary forest and provides the traditional Waorani thatch. The leaves, which are applied in three layers on an A-framed longhouse, are not particularly durable, lasting at the most one year. In recent years, the Waorani have turned to other more durable palms, largely in imitation of their lowland Quichua neighbours.

Geonoma sp.
Collect.: Davis & Yost 960
Waorani Informant: Geque (m). Downriver dialect: n.v. *ted-enowɇncabo*

This medium-sized (3 m.) palm of the primary forest supplies leaves for wrapping food; the seeds provide material for beads.

Geonoma sp.
Collect.: Davis & Yost 1015
Waorani Informant: Geque (m). Downriver dialect: n.v. *oomawɇ*

This palm is a 4-meter treelet of the primary rain forest. It is used to improvise hunting and war spears. Before the arrival of metal tools that could cut chonta (*Bactris Gasipaes*), spears were fashioned from this palm exclusively.

Jessenia Bataua (Mart.) Burr. in Notzbl. 10 (1928) 300.
Collect.: Davis & Yost 1004.
Waorani Informant: Geque (m). Downriver dialect: n.v. *petowɇ*

This palm which is a common tree (30 m. tall) of the primary forest is one of the most important Waorani plants. The leaves provide thatch; the fibrous leaf bases are broken up and used to clean the bore of blowguns, to start fires and to make flares; the fruit, if boiled, turns very hard, but upon gentle warming, provides a delicious, oily paste; the adventitious roots are employed medicinally to treat worms, diarrhea, headaches and stomach ailments.

As with most of the palms, the Waorani used derived terms to refer to the various plant parts. The fruits are *petomo*, the leaves *petoba*, the fibrous leaf bases *petocoo* and the adventitious roots *peto*. The mature tree is known as *petowɇ*.

In Colombia, this species is an important medicine. In the eastern llanos, the oil of the fruit has been used for forty years to treat tuberculosis and other pulmonary ailments. It is also esteemed in treating bronchial problems and colds and may be taken orally or injected (García-Barriga 1974, Perez Arbeláez 1956). In the Darien, Panama, the oil is considered an anodyne (Duke 1968).

Maximiliana aff. **Maripa** (Correa) Drude in Martius, Fl. Bras. 3, pt. 2 (1882) 452.
Collect.: Davis & Yost 963.
Waorani Informant: Geque (m). Downriver dialect: n.v. *oompa*

An enormous tree attaining a height of 50 m. in the primary forest, this tree is very important for the Waorani. The petiole is split and cut into short lengths for making darts for blowguns. The fruits are eaten as food and used in an infusion to treat colds.

Again, the Waorani refer to the various stages of growth by separate terms. The seeds are called *gaibamo*, and larger saplings are called *nampacagi*, until the plant reaches maturity. Once it has born fruit, the tree is called *oompa*.

Phytelephas macrocarpa Ruiz et Pav. in Syst. Veg. 301 (1798).
Collect.: Davis & Yost 997.
Waorani Informant: Nangɇ. Upriver dialect: n.v. *wamowɇ*

This palm, called *tagua* in Spanish, is a medium sized tree (8 m.) growing on disturbed ridgetops, or along the river banks throughout Waorani territory. It has a brown, woody basal fruit (*wamomo*) with a delicious white, fleshy pulp much esteemed by the Indians. The stem (*wamoncagi*) is for crowns and improvised darts, the leaf (*wamonta*) for baskets, and the fibre (*wamongi*) for brooms, torches, fire starters or blowgun bore-cleaner.

The fruits contain from six to nine seeds with a thin brown layer on the outside and a very hard endosperm which is the source of vegetable ivory. At one time Ecuador was the chief exporting nation of this commodity and many indigenous tribes were involved in the collection of the seeds. The Waorani were not affected by the vegetable ivory trade and did not participate.

Socratea exorrhiza H. Wendl. in Bonplandia, 8 (1856) 264.
Collect.: Davis & Yost 948.
Waorani Informant: Geque (m). Downriver dialect n.v. *ɏɇdemo*

This extremely hard forest tree of 30 m. has a conspicuous, edible, yellow fruit. The Waorani use the hard wood to make peccary spears.

Wettinia cf. **guinaria** (Cook et Doyle) Burr. in Notizbl. 10 (1930) 941.
Collect.: Davis & Yost 1049.
Waorani Informant: Tomo & Cɇnto (m). Upriver dialect: n.v. *cayewebɇwɇ*

This medium-sized tree (15 m.) of the primary forest is characterized by brown urticating hairs on the fruit. The wood is used for spears and blowguns when no chonta (*Bactris Gasipaes*) is available. The leaves provide emergency thatch.

Undetermined specimen of Palmae
Collect.: Davis & Yost 949.
Waorani Informant: Geque (m). Downriver dialect: n.v. *giyi-cabɇmo*

A small palm that attains 4 m. in the primary forest, this treelet has small, hard, black fruits which are shot through blowguns to kill small birds.

Undetermined specimen of Palmae
Collect.: Davis & Yost 1016.
Waorani Informant: Geque (m). Downriver dialect: n.v. *omacabo*

The leaves of this 6 m. palm are especially resistant to rot and, consequently, are highly prized as thatch. The fruits are edible.

Undetermined specimen of Palmae
Collect.: Davis & Yost 929.
Waorani Informant: Taade (m). Ridge dialect: n.v. *tepa*

This large 20 m. tree grows in the primary rain forest; the wood is employed for blowguns.

The Waorani also use the various species of chonta (*Bactris Gasipaes* and *Iriartea* sp.) to make blowguns. Two matching sections of wood 3 meters long by 3 centimeters thick are longitudinally grooved and bound together so that the grooves form a 1-centimeter bore the length of the blowgun. The two pieces are wrapped with a vine (*Heteropsis* sp.) and sealed with beeswax. The bore is then enlarged and polished with fine sand and water as an abrasive. The result is a surprisingly straight, highly polished bore. Compared to other Amazonian blowguns, these are rather heavy but very efficient.

Cyclanthaceae

Cyclanthus sp.
Collect.: Davis & Yost 965.
Waorani Informant: Geque (m). Downriver dialect: n.v. *wino*

In past generations, the men folded the leaves of this small unidentified plant of the primary forest floor to fashion a long penis sheath, while the women hung a flap of the leaf over a G-string; but by the time of contact, this practice had died out.

Araceae

Heteropsis sp.
Collect.: Davis & Yost 951.
Waorani Informant: Geque (m). Downriver dialect: n.v. *otome*

The bark of this liana is used to bind the two halves of a blowgun, to make baskets and to lash together beams for house construction. It is the strongest liana of the forest and holds its shape for a long time. The Waorani name *otome* means 'basket vine'. The Waorani eat the yellow fruit and recognize that animals and birds such as woolly monkeys (*Lagothrix lagotricha*), toucans (*Ramphastos cuvieri*) and oropendolas (*Zarhunchus wagleri*) also frequently feed on it.

Philodendron sp.
Collect.: Davis & Yost 1023.
Waorani Informant: Cento (m). Downriver dialect: n.v. *ome*

The root and the stem of this liana are crushed in hot water, and the decoction is drunk two or three times daily by victims of *cayatamo* (*Bothrops castelnaudi*) bite, one of eight venomous snakes found in Waorani territory.

Other authors have suggested that several species of Philodendron in the northwest Amazon have pharmacologically active principles. The leaves and petioles of *Philodendron craspedodromum* R.E. Schultes provide a piscicide among the Desana Indians of the Rio Papurí, Colombia: the leaves are cut, tied into

a bundle and left to ferment for two days before being crushed and thrown into the water to stun fish (Schultes in prep.). The Kubeos and other tribes of the Vaupés in Colombia use the pulverized and dried inflorescences of *Philodendron dyscarpium* R.E. Schultes as a contraceptive: the powder is added to the food of the women (Schultes in prep.).

Undetermined specimen of Araceae.
Collect.: Davis & Yost 962.
Waorani Informant: Geque (m). Downriver dialect: n.v. *cowẹntobẹcagi*

This unidentified climbing epiphyte of the primary forest has a conspicuous red spadix and a compound leaf with ten segments. The aroid is used to treat warble fly infestations (*Dermatobius hominus*) by rubbing the sap from the fruit over the infected spot to draw out the larva.

Because the palmate leaf is said to resemble that of yuca (*Manihot esculenta*), the plant is ritually brushed over children so that they will grow up able to raise ample supplies of yuca.

Dioscoreaceae

Dioscorea trifida L., Suppl. Plant Syst. Veg. (1781) 427.
Collect.: Davis & Yost 992.
Waorani Informant: Oncaye (f). Downriver dialect: n.v. *cowango*

The Waorani cultivate this liana for its edible tuber by propagating it vegetatively with pieces of the tuber. It is commonly planted around house sites or along the margin of cultivated plots.

Musaceae

Musa paradisiaca L., Sp. Pl. (1753) 1043.
Collect.: Davis & Yost s.n.
n.v. *pẹẹnẹ*

The Waorani widely cultivate plantains, which rank in importance with yuca (*Manihot esculenta*) and chonta (*Bactris Gasipaes*) as a source of carbohydrate. Some Waorani families use it

more than other families, depending much on personal preference. It is boiled when ripe and served as a drink or boiled with meat when yet green.

ZINGIBERACEAE

Costus erythrocoryne K. Schum. in Engler, Pflanzenr., Zingib. 4:46 (1904) 410.
Collect.: Davis & Yost 1029.
Waorani Informant: Cento (m). Downriver dialect: n.v. *gonɇquemo*

A common herb of river banks and flats, this species is a favorite of Waorani children who suck the spicy water from the mature fruits as a condiment. Adults also suck on it to stave off hunger while traveling through the forest.

The Taiwano and Kabuyarí Indians of the Amazon of Colombia use the powdered leaves as a snuff to staunch persistent nose-bleed (Schultes in prep.).

Costus scaber R. et P., Fl. Peru: 1, pt. 2 (1798) t.s.
Collect: Davis & Yost 940.
Waorani Informant: Geque (m). Downriver dialect: n.v. *odɇngimoncagi*

Costus scaber, a low herb of the primary forest, is valued as a condiment by the Waorani. The spicy stem is commonly sucked as refreshment.

Dimerocostus strobilaceus in O. Kuntze ssp. *strobilaceus* Maas in Fl. Neotrop., 8 (1972) 22.
Collect.: Davis & Yost 1028.
Waorani Informant: Cento (m). Downriver dialect: n.v. *nɇnɇnquemo*

The fruits of this 3 m. scandent herb are sucked as refreshment by Waorani children.

Renealmia Asplundii Maas in Flora Neotrop. 18 (1977).
Collect.: Davis & Yost 933.
Waorani Informant: Geque (m). Downriver dialect: n.v. *tɇɇntemo*

This low herb of the primary forest is one of the main Waorani snakebite remedies. After the stem is pounded to a pulp and mixed with water, the infusion is drunk once a day to reduce swelling until the patient is cured. It is employed specifically for the jergon or fer-de-lance (*Bothrops atrox*), known as *nẹnẹnẹnca*.

Other species of *Renealmia* are reputed to have medicinal properties. In Brazil, the seeds of *Renealmia domingensis* Horan. are believed to control menstruation. The juice of this plant was apparently used by the Maya to treat hemorrhoids (Usher 1974).

The Wai-wai Indians of Guyana boil the entire plant of *Renealmia pedicellaris* A.C. Smith and bathe in the decoction to reduce fever (Altschul 1973).

Renealmia thyrsoidea (R. et P.) P. et E., Nov. Gen. et Sp. 2 (1838) 25. t. 134.
Collect.: Davis & Yost 934, 935.
Waorani Informant: Geque (m). Downriver dialect: n.v. *tẹẹntẹ-cagi*

The Waorani recognize two varieties of this species: one, known as *tẹẹntẹmo* (D 934), has yellow flowers and bright red bracts; the other, *tẹẹntẹcagi* (D 935), has a conspicuous black lip on the corolla and pink bracts. Both forms are valued in treating snakebite by crushing the stem and drinking an infusion once a day to prevent swelling.

Renealmia sp.
Collect.: Davis & Yost 1024.
Waorani Informant: Cento (m). Downriver dialect: n.v. *tẹẹntẹbo*

Like other species of this genus, this low growing herb of the primary forest is esteemed in treating snakebite. The stem is crushed and a hot infusion, drunk once a day, is said to reduce swelling and internal bleeding.

Maranthaceae

Calathea Standleyi Macbr. in Publ. Field Mus. Nat. Hist., Bot. Ser., 11 (1931) 54.

Collect.: Davis & Yost 941.
Waorani Informant: Geque (m). Downriver dialect: n.v. *oyon-cabo*

Because the leaves of this common species are flexible and do not split when bent or rolled, they are used to wrap cooked meat, fish, yuca and other foods.

Some species of *Calathea* have been employed as medicine in the northwest Amazon. The Kofan of Ecuador boil the leaves of *Calathea roseo-pieta* Regel to prepare a medicine for treating mouth sores (Schultes in prep.). *Calathea Veitchiana* Veitch ex Hooker fil. is often added to *Banisteriopsis Caapi* (Spr. ex Gris.) Morton in preparing an hallucinogenic drink in the northwest Amazon.

Ischnosiphon obliquus (Rudge) Koern. in Nouv. Mem. Soc. Nat. Mosc. 11 (1859) 341.
Collct.: Davis & Yost 1045.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *gaya-quewencagi*

The Waorani use the stems of this common herb of the seasonally inundated bottomlands as peace spears at festivals. The guests thrust the pliable 'spear' into the ground in front of the host, demonstrating their intent to be peaceful during their visit.

Orchidaceae

Selenipedium sp.
Davis & Yost 1048.
Woarani Informant: Tomo (m). Upriver dialect: n.v. *menega-gowé*

This terrestrial orchid is said to attain 5 m. in height. The erect hollow stem is utilized as a training blowgun for young Waorani boys, and in an emergency may also be used by adults as an improvised blowgun.

Piperaceae

Piper augustum Rudge, Icon Pe. Gui. (1805) 10. t. 7.
Collect.: Davis & Yost 938.
Waorani Informant: Geque (m). Downriver dialect: n.v. *nɇmpocao*

The Waorani break the stems of this shrub off and use them as tooth brushes. The ancestors employed this plant to prevent tooth decay and deliberately blacken teeth.

Various species of *Piper* have been reported as medicines in the northwest Amazon. In the Colombian Amazon, a poultice of the leaves of *Piper Hostmannianum* (Miq.) C. DC., is applied to warts to hasten their disappearance. The Culina Indians of eastern Peru prepare a snuff from the dried leaves and roots of *Piper interitum* Trel. ex Macbride as a tobacco substitute; the essential oils may have psychoactive properties. The Karijonas of the upper Vaupés treat bronchial ailments, including tuberculosis, by preparing a hot tea of the leaves and stems of *Piper Schultesii* Yunck, which serves as a strong diuretic. The Kofan of Ecuador crush the aromatic leaves and stems of *Piper serpens* (Sw.) Loudon to apply as a poultice to relieve the sting of the large "conga" ant (Schultes in prep).

Piper conojoënse Trel. et Yunck., Piperaceae Northern S. Am. (1950) 46.
Collect.: Davis & Yost 939.
Waorani Informant: Geque (m). Downriver dialect: n.v. *yacabɇw*

The stems of this common shrub are broken off at the nodes and used as tooth brushes by the Waorani. The ancestors are said to have used this plant to turn teeth black, and it was thought to prevent tooth decay.

Moraceae

Cecropia sciadophylla Mart. in Flora, 24 (1841) pt. 2. Beibl. 93.
Collect.: Davis & Yost 921.
Waorani Informant: Taade (m). Ridge dialect: n.v. *mangimɇo*

This common tree, which yields a delicious fruit similar in taste to figs, is a delicacy to the Waorani. Toucans (*Ramphastos cuvieri*) and piping guans (*Pipile pipile*) are said by the Waorani to prefer the fruits of this species.

Most indigenous groups in the northwest Amazon consider the fruits of *Cecropia* unpalatable (Schultes, pers. comm.). Many groups burn the leaves of this species to obtain an alkaline admixture for coca chewing. Certain species of *Cecropia* are used medicinally in the Amazon. The juice from the stem of *Cecropia peltata* L. is used in Brazil to treat dysentery (Usher, 1974). *C. tolimensis* Schultes et Villarreal has fruits which are taken in Colombia to treat fever (Altschul, 1973).

Ficus maxima Miller, Gard. Dict., ed. 8 (1768) No. 6.
Collect.: Davis & Yost 1040.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *corotamo*

The inner bark is pounded and peeled off as a single tube-shaped piece to make cloth slings for carrying children or storage bags for kapok (*Ceiba pentandra* (L.) Gaertn.). This is one of six reported species that the Waorani use for bark cloth.

Perebea guianensis Aubl., Hist. Pl. Gui. Franc. 2 (1775) 953. t. 361.
Collect.: Davis & Yost 1009.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *bataca*

The sap of this species is esteemed as hair oil, and the spiny dried fruit serves as a comb or hair brush.

URTICACEAE

Urera baccifera (L.) Gaud. Freyc., Voy. Bot. (1826) 497.
Collect.: Davis & Yost 956.
Waorani Informant: Geque (m). Downriver dialect: n.v. *wẹnto*

All surfaces of this scandent shrub are covered with urticating hairs. The Waorani utilize the leaves either to punish children or as a means of transferring their own adult strength to the children. In the latter instance, an adult may return from a long hard day in

his gardens, gather the village children, and then brush each child with the painful plant to instill in them his own ability to work hard.

The Waorani also use this plant to relieve fainting and all pain, including that from aching muscles, arthritis, pulled muscles, snakebite, stingray and stings of the conga, azteca and fire ants.

The roots of *Urera baccifera* are said in the Colombian Amazon to have antihemorrhagic properties, and an infusion of the leaves alleviates erysipelas (Garcia-Barriga 1974). In Puerto Rico, a decoction of the roots is employed in treating gonorrhea (Usher 1974).

Menispermaceae

Curarea tecunarum Barn. et Kruk. in Mem. New York Bot. Gard., 22:2 (1971) 12.
Collect.: Davis & Yost 943.
Waorani Informant: Geque (m). Downriver dialect: n.v. *oonta*

This species is well recognized as one of the principal sources of an especially strong arrow and dart poison prepared in the northwestern Amazon. It is the most important source of poison for the Waorani, and the preparation of curare from it is a highly esteemed skill.

The outer bark of the liana is shaved, shredded and placed in a funnel-shaped leaf compress suspended between two hunting spears. Cold water is then percolated through and the drippings collected in a small ceramic pot. This dark-colored liquid is slowly heated over a fire and brought to a frothy boil numerous times until the fluid thickens. It is then cooled and later reheated, until a thin layer of viscous scum gradually forms on the surface. This scum is removed, the dart tips are spun in the viscid fluid and the darts are finally carefully dried by the fire.

Curarea tecunarum may have important medicinal properties as well. The Waorani apply the prepared poison directly to skin infections, bacterial or fungal, with proven results. Some Waorani have been known to ingest small amounts of the poison to treat stomach-ache and diarrhea. The Deni Indians of Brazil

crush the stems and let them soak in water with stirring; the resulting tea is drunk as a contraceptive (Schultes 1982).

Amazonian arrow-poisons have been the source of several important medicines in our Western pharmacopoeas. The strength of this species as a poison and its reported use as both a contraceptive and an anti-fungal agent strongly suggest the advisability of further phytochemical investigation.

ANNONACEAE

Guatteria cf. **Schunkevigoi** Simpson in Phytologia, 30(5) 307 (1975).

Collect.: Davis & Yost 1011.

Waorani Informant: Tomo (m). Upriver dialect: n.v. *menedowę*

When the bark of this forest tree is crushed and mixed with water, the pulp and water are rubbed over the head and shoulders of febrile individuals to force the "fever to flee."

MYRISTICACEAE

Iryanthera cf. **elliptica** Ducke in Journ. Wash. Acad. Sci. 26 (1936) 219.

Collect.: Davis & Yost 1020.

Waorani Informant: Cento (m). Downriver dialect: n.v. *awa-moncawę*

The resin of this tree of the primary forest is a recognized antifungal agent. The Waorani remove the inner bark, twist the cambium and apply the resin directly onto infected areas. It is also used to kill mites and scabies. This plant is said to be appreciably stronger than *Virola peruviana* (A. DC.) Warb. (*Davis 1019*).

Iryanthera juruënsis Warb. ex Pilger in Verh. Bot. Ver. Brand. 47 (1905) 137.

Collect.: Davis & Yost 1014.

Waorani Informant: Geque (m). Downriver dialect: n.v. *wingi-moncawę*

This tree of the primary forest attains a height of 50 m. The copious "resin" of the inner bark oxidizes to a brilliant red. The Waorani say that, when applied directly to fungal infections, the

resin kills the fungus "just like the dart poison" (*Curarea tecun-arum*).

Iryanthera Ulei Warb. contains 5-Me0-DMT (5-Methoxy-N, N-dimethyltryptamine) in its bark. Among the Bora and Witoto of the Rio Ampiyacu in Peru, *I. Ulei* and *I. macrophylla* (Benth.) Warb. together with several species of the related genus *Virola* (*V. elongata* (Benth.) Warb., *V. surinamensis* (Rol.) Warb., *V. loretensis* A.C. Smith) are the sources of an oral hallucinogen (Holmstedt et al 1980). Recent fieldwork among the Bora has added *V. divergens* Ducke, *V. calophylla* Warb., *V. Pavonis* (A. DC.) A.C. Smith and *Iryanthera longiflora* Ducke to the list of hallucinogens from these two remarkable genera. The Waika of Venezuela also use many species of *Virola* either as hallucinogenic snuffs or as arrow-poisons. The principal species employed by the Waika are *V. calophylla* Warburg, *V. theiodora* (Spr. ex Bth.) Warb. and *V. calophylloidea* Markgraf.

Iryanthera cf. **paraënsis** Hub., in Bol. Mus. Para. (1910) 69.
Collect.: Davis & Yost 1005.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *wecaiwɇ*

The inner bark of this medium-sized tree (15 m) is scraped and pounded and applied directly to fungal infections and infestations of mites.

Otoba parvifolia (Mkf.) A. Gentry in Notizbl. 9 (1926) 964.
Collect.: Davis & Yost 1008.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *aɪɇpɇwɇ*

Although the bark and bright red resin of this bushy plant are crushed and rubbed on the skin as a treatment for the bites of mites and fungus infections, the Waorani say that it is rarely used.

Several species in this genus are used throughout the northwest Amazon as an antifungal agents. The Tikuna Indians of Colombia call this species *sangre toro*; and, in the Napo region of Ecuador, it is known in Spanish as *sangre gallina*. In both areas, the Indians assert that the resin has medicinal properties (Acero Duarte 1979).

Virola calophylla Warb. in Nov. Act. Nat. Cur. 68 (1897) 231.
Collect.: Davis & Yost 1019.
Woarani Informant: Cento (m). Downriver dialect: n.v. *tegidewé*

The inner bark of this forest tree is squeezed and the copious red "resin" is applied to fungal infections, scabies and infestations of mites. The Kubeo and Tucano Indians of the Rio Vaupés employ the fresh bark resin of *V. albidiflora* Ducke to treat skin sores (Schultes in prep.). The "resin" of *V. calophylla* and *V. calophylloidea* is processed and snuffed as an hallucinogen by the Kubeo, Puinave, Kuripaco, Barasana, Makuna and Taiwano of the Vaupes of Colombia. The nomadic Makú of the Rio Pirapa-raná ingest the exudate of the inner bark of *V. elongata* (Benth.) Warb. directly, without any of the elaborate preparation practiced by other tribes of the region (Schultes and Hofmann, 1980).

In Brazil, the "resin" of *V. surinamensis* (Rol.) Warb. is used to treat erysipelas, and an infusion of the bark is applied as a wash to cleanse wounds (Schultes in prep.).

Monimiaceae

Siparuna sp.
Collect.: Davis & Yost 923, 1052.
Waorani Informant: Taade (m). Ridge dialect: n.v. *nonangonca*

The red fruits of this scandent forest shrub are used by the Waorani to treat fever and headache. When crushed, the leaves and fruits are very pungent and are rubbed directly onto the face and head.

Leguminosae

Arachis hypogaea L., Sp. Pl. (1753) 741.
Collect.: Davis & Yost s.n.
n.v. *coromo*

The common peanut is one of the traditional cultigens of the Waorani.

Dialium guianensis (Aubl.) Sandw. ex A.C. Smith in Lloydia, 2 (1939) 184.

Collect.: Davis & Yost 1057.
Waorani Informant: Cẹnto (m). Downriver dialect: n.v. *dicademo*

The fruits of this 70 m. forest tree, either green or ripe, may be eaten dry or, preferably, soaked in water.

Enterolobium sp.
Collect.: Davis & Yost 1026.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *cẹnimowẹ*

Crushed and dropped directly into small streams, the bark of this tall (60 m.) forest tree serves as a fish poison. A hot decoction of the bark is valued also as a fungicide.

Inga sp.
Collect.: Davis & Yost 976.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *iwa ao*

The Waorani eat the white flesh surrounding the black seeds of this tall forest tree, which has characteristic brown fruits covered with urticating hairs.

Inga sp.
Collect.: Davis & Yost 953.
Waorani Informant: Geque (m). Downrivr dialect: n.v. *ẹwẹmao, wenemẹngo*

The yellow-green fruits of this tall (40 m.) forest tree may be eaten, but according to the Waorani, if more than five of the seeds are ingested, vomiting occurs.

The Waorani recognize the fruit as a preferred food of all monkeys, the scarlet macaw (*Ara macao*), the mealy parrot (*Amazona farinosa*), and the dusty-headed parrotlet (*Forpus sclateri*).

Lonchocarpus Nicou (Aubl.) DC. *var.* **languidus** F.J. Herm. in Journ. Wash. Acad. Sci. 37 (1947) 111.
Collect.: Davis & Yost 979.
Waorani Informant: Oncaye (f). Downriver dialect: n.v. *compago.*

This was one of the traditional Waorani fish poisons, but it has been largely replaced by *Clibadium asperum* (Davis 294), (acquired from neighbouring lowland Quichua) bcause it is more effective on the larger streams and rivers where many of the Waorani now live. The Waorani still plant *Lonchocarpus Nicou* in their chacras, however, and use it in small feeder streams. They pound the root to a pulp and place it directly in the small, slow brooks where the effects are almost immediate.

Lonchocarpus Nicou is widely known as barbasco in the northwest Amazon; its root contains 20% rotenone (Usher 1974).

Lonchocarpus Nicou (Aubl.) DC. *var.* **Urucu** Killip & Smith in Journ. Wash. Acad. Sci. 37 (1947) 111.
Collect.: Davis & Yost 968.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *méneco*

This variety of *Lonchocarpus Nicou* is also used by the Waorani, who semi-cultivate it by planting it throughout the forest. They use it in the same way as they do variety *languidus*, crushing the wood and root and casting them directly into a stream.

Pachyrhizus angulatus Rich ex DC., Prodr. 2 402.
Collect.: Davis & Yost s.n.
n.v. *capamo*

The Waorani cultivate the yam bean as a snack food to be eaten raw.

Undetermined specimen of Leguminosae.
Collect.: Davis & Yost 1006.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *acowé*

The bark of this tall (80 m.) forest tree is crushed and employed as a fish poison. An infusion of the bark is also applied to treat fungal infections and infestations of mites and scabies. Since contact, Waorani have washed their clothes in a bath prepared with this bark to eliminate scabies.

Simaroubaceae

Picramnia cf. **Spruceana** Engl. in Martius, Fl. Bras 12, pt. 2 (1877) 238.

Collect.: Davis & Yost 1012.
Waorani Informant: Geque (m). Downriver dialect: n.v. *degintai gipɇnii*

The leaves of this subcanopy tree are crushed to prepare an infusion which is used as a purple dye for fish nets, hammocks and carrying bags.

Picramnia sp.
Collect.: Davis & Yost 1010, 1032.
Waorani Informant: Cɇnto (m). Downriver dialect: n.v. *degintai gipɇnii*

The leaves are also crushed and soaked in water overnight, and the infusion is utilized as a purple dye for fish nets and carrying bags.

Burseraceae

Protium sp.
Collect.: Davis & Yost 1021.
Waorani Informant: Cɇnto (m). Downriver dialect: n.v. *wingi-tagɇ*

The fruits of this tall (60 m.) forest tree are edible.

Malpigiaceae

Banisteriopsis muricata (Cav.) Cuatrecasas in Webbia 13 no. 2 (1958) 490.
Collect.: Davis & Yost 967, 975.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *mii*

This liana is the only hallucinogenic plant currently employed by the Waorani. Although both collections were made at the edge of chacras, the Waorani maintain that the plant is not cultivated, and frequently point it out as growing wild along river banks.

Whereas the use of the related hallucinogen *Banisteriopsis Caapi* is almost everywhere in the western Amazon defined as a social event, the imbibing of the drink prepared from *B. muricata* is a solitary experience among the Waorani. In the all-night ceremony, during which the *ido*, or shaman, is accompanied only

by his wife, the *ido* prepares the drug by scraping the bark and slowly boiling the brew.

According to our informants, the use of this drug is considered an aggressive act. It may be taken to cure illness but only if prepared by the one who caused the illness in the first place. "If someone consented to cure, it was an admission of guilt. If he didn't cure the victim, he would be killed. Sometimes he was killed after curing someone, because he was the one who caused it."

The Waorani call this species *mii* and clearly associate certain powers with it. A boy's uncle or grandfather will take a tiny piece of the liana and, using the windpipe from a toucan, piping guan or curassow as a blowgun, bow the wadded *mii* into the boy's lungs so that he will grow up to have powerful lungs and become a great hunter.

The Witoto of Puco Urquillo on the Rio Ampiyacu in Peru call it *sacha ayahuasca*—"wild ayahuasca"– and say that it can be used just as ayahuasca (*B. Caapi*), but that it is weaker.

Hiraea sp. nov.
Collect.: Davis & Yost 1038.
Woarani Informant: Tomo (m). Upriver dialect: n.v. *dowemenei*

The fruit of this liana of the primary forest canopy is eaten.

Dichapetalaceae

Tapura amazonica P. et E., Nov. Gen. et Sp. 3 (1845) 41 t. 246. f. 2.
Collect.: Davis & Yost 1044.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *awɇn-catomo*

The Waorani eat the fruits of this primary forest tree.

In the northwest Amazon a related species, *Tapura peruviana* Krause, (known in Colombia as *calentura chiricaspi*) is used medicinally: an infusion of the leaves is taken to reduce fevers (Schultes in prep.).

Hevea guianensis Aubl., Hist. Pl. Gui. Franç. 2 (1775) 871.
Collect.: Davis & Yost 1018.
Waorani Informant: Cento (m). Downriver dialect: n.v. *noogowę*

The latex of this 60 m. forest tree is placed over warble fly infestations, where it hardens into rubber and suffocates the larva. The latex is also drunk as a tonic to make one strong.

Manihot esculenta Crantz., Inst. 1 (1766) 167.
Collect.: Davis & Yost 980, 981, 983, 984, 985, 986, 987, 988, 989, 990, 991, 998
Waorani Informant: Oncaye (f). Downriver dialect: n.v. *quewe* (growing plant), *cęęne* (tuber)

While the Waorani are known for their hunting abilities, they depend on gardens for a large portion of the diet, and their principal source of carbohydrate is yuca (*Manihot esculenta*).

Although the Waorani are technically swidden agriculturalists, their method of propagating yuca is better termed slash-and-rot than slash-and-burn. Both men and women prepare the site by clearing out the underbrush, and then the women plant the cuttings at a 10 to 30 degree angle. All work is done in the shade, since the large trees are cut down by the men. The fields are only rarely burned off, and the Waorani prefer to plant either in a climax forest area or in an area that has lain fallow for a dozen or more years. The yuca, once planted, is the domain of the women who do all the planting, weeding and harvesting. They also prepare it for consumption, usually in the form of *tepę*, a mildly fermented beverage made by mixing small portions of masticated boiled pieces of the roots with large quantities of boiled root material mashed into a paste. The paste is fermented overnight and then mixed with water and drunk. The Waorani adult consumes from four to seven liters of *tepę* (containing approximately 500 grams of yuca mash per liter) each day, but he also eats much yuca boiled with meat whenever meat is available.

The Waorani recognize at least twenty varieties of sweet yuca, all of which are referable to *Manihot esculenta*.

a) *Ɇwɇmongɇwe* — (Davis & Yost 980) This form is known as the "scarlet macaw's yuca", as the fruit is bright red. It grows to 3 m., has red petioles, deep purple leaves and a large root 10 cm. thick and up to 0.5 m. long.

b) *Genempacawe* — (Davis & Yost 981) Attaining a height of 4 m., this form has dark green leaves and a white root.

c) *Ɇdɇbɇi* — (Davis & Yost 982) The "leaning yuca", is a variety which was much used by the ancestors. The leaves are light green, and the root measures 0.6 m. long and .15 m. wide. The flowers are pink.

d) *Gimatoye* — (Davis & Yost 983) Growing luxuriantly on well drained hillsides, this variety has a very short white tuber, white flowers and light green leaves. It is especially valued as a yuca to be consumed with howler monkey meat.

e) *Opatawɇye* — (Davis & Yost 984) This plant, "red yuca", is an especially hardy form that does well on hillsides. The root is not so sweet as other varieties, so many Waorani do not plant it.

f) *Namɇntawe* — (Davis & Yost 985) This type, which has a soft root, grows best on lowland terraces on well drained sites and is the sweetest of all forms recognized by the Waorani. The Waorani name means "white yuca."

g) *Wengoicawe* — (Davis & Yost 986) This type has a root up to 0.6 m. long and a sweet flavor.

h) *Iwanca* — (Davis & Yost 987) The "howler monkey yuca" has a red, very sweet root.

i) *Dawaquewe* — Another hardy variety that grows well on all sites, this form is known as the "true yuca" and produces a large, very sweet root.

j) *Gitaincawe* — (Davis & Yost 989) This form is the "small yuca" which produces a short, stout root only 0.3 m. long.

k) *Equemowe* — (Davis & Yost 990) Producing an enormous root as large as a human leg, this kind does well on hillsides.

l) *Itɇcawe* — (Davis & Yost 991) The "yellow yuca" has a very small, yellow root 0.5 m. long and 3 cm. thick.

m) *Dooɨ̨we* — (Davis & Yost 998) This kind grows to 8 m. tall and is called the "tall yuca." It is the fastest growing type used by the Waorani and is reported not to flower; it produces a white, medium sized, sweet root.

Several other Waorani forms were mentioned by informants but not collected.

n) *Wegompaca* — One of the "ancestor's yuca", this type is eaten with howler monkey meat but never with that of the woolly monkey. Like all of the ancestor's yucas, it is not very sweet. It is planted selectively by only a few individuals.
o) *Moncatadewe* — A very tall, unbranching form which produces a root that is red on the outside and white inside and quite sweet.
p) *Tapadɨ̨* — A very tall form.
q) *Bebawe* — The slowest growing kind.
r) *Equemotawe* — A difficult form to grow. If not well weeded, it rots because the soil is too damp.
s) *Tamawe* — An undescribed form.
t) *Badɨ̨pancawe* — An undescribed form.

Sapindaceae

Paullinia alata (R. et P.) G. Don subsp. *loretana* Macbr. in Bot. Ser. Field Mus. 13, pt. 3A, no. 2 (1956) 330.
Collect.: Davis & Yost 1039.
Waorani Informant: Cɨ̨nto (m). Downriver dialect: n.v. *tɨ̨ɨ̨nɨ̨-moneca*

The informant was aware of no use for this plant, but, since it had a name, he concluded that it must have been used once by the *Doorani*, the ancesters. The Waorani name, *tɨ̨ɨ̨nɨ̨moneca*, contains the morpheme for "viper," so it is conceivable that it was used to treat snakebite.

Several species of *Paullinia* are employed medicinally in the northwest Amazon. The Karijona Indians of the Colombian Vaupés make an emetic of the leaves of *P. emetica* R.E. Schultes

(Schultes in prep.). *Paullinia Yoco* Schultes & Killip is used by the Inga, Siona, Kofan and Koreguaje Indians in Colombia, and it has been called the "most important non-alimentary plant in the economy of the natives of the Putumayo" (Schultes 1942a). The epidermis, cortex and phloem are mixed with cold water to make an extremely stimulating caffeine-rich beverage, which has also been used as an anti-malarial febrifuge in the Putumayo (Schultes 1942a).

Malvaceae

Gossypium barbadense L., Sp. Pl. (1753) 693.
Collect.: Davis & Yost 920.
Waorani Informant: Taade (m). Ridge dialect: n.v. *dayo*

The Waorani cultivate cotton to make their G-strings and ceremonial arm bands. They also use it to decorate hunting and war spears.

Bombacaceae

Ceiba pentandra (L.) Gaertn. in Fruct. 2 (1791) 244. t. 133.
Collect.: Davis & Yost s.n.
n.v. *bobɇwɇ*

Kapok fibre from this forest tree is spun onto poison darts to serve as fletching and an air seal between the dart and blowgun. The kapok fibre is called *co*, but the tree is termed *bobɇwɇ*.

Sterculiaceae

Herrania nitida (P. et E.) R.E. Schultes in Caldasia 2 (1943) 13.
Collect.: Davis & Yost 1030.
Waorani Informant: Cɇnto (m). Downriver dialect: n.v. *boginca*

The Waorani eat the cauliflorous fruit of this species.

Theobroma sp.
Collect.: Davis & Yost 927.
Waorani Informant: Taade (m). Ridge dialect: n.v. *mɇneca, tobanaaca*

The delicious pulp of the cauliflorous fruits of this forest tree is eaten.

Undetermined specimen of the Sterculiaceae
Collect.: Davis & Yost 1001.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *bogiwé*

The green cauliflorous fruit of this 7 m. tall tree of the primary rain forest is edible and is known as *boginca*. The capuchin monkey and the squirrel monkey (*Saimiri sciurea*) eat it as well.

Marcgraviaceae

Marcgravia sp.
Collect.: Davis & Yost 954.
Waorani Informant: Geque (m). Downriver dialect: n.v. *namontaque*

Children eat the orange-red fruits of this liana of the mid-canopy, and adult hunters recognize that it is consumed commonly by toucans (*Ramphastos cuvieri*), and various species of toucanets, aracaries and oropendolas.

Souroubea sp.
Collect.: Davis & Yost 972.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *Oonta*

The bark of this liana is used to wrap the blowgun halves together. *Oonta* is the same name that the Waorani give to the curare liana, *Curarea tecunarum*.

Various species of *Souroubea* have been used medicinally in the northwest Amazon. The Indians of the Rio Apaporis use an astringent tea of the leaves of *Souroubea crassipetala* de Roon to treat mouth sores. The Karijona on the upper Vaupés in Colombia take a tea of the leaves of *S. guianensis* var. *cylindrica* Wittm. as a tranquilizing medicine, and the Taiwanos of the Rio Kananari of Colombia use a decoction of *S. guianensis* var. *corallina* (Mart.) Wittm. to calm apprehensive elderly tribal members who believe that they have been hexed (Schultes in prep).

Guttiferae

Rheedia Spruceana Engl. in Martius, Fl. Bras. 12, pt. 1 (1888) 463.
Collect.: Davis & Yost 974.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *contaca*

The Waorani eat the fruit of this 50 m. forest tree and recognize that most species of parrots and macaws also feed on it.

Tovomita sp.
Collect.: Davis & Yost 1003.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *gingamonca*

The exocarp and the flesh of the fruits of this tall canopy tree of the primary rain forest are removed, and the hard shell is used to measure water to make dart poison.

Vismia sp.
Collect.: Davis & Yost 970.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *gaca-menɇwɇ*

This 30 m. forest tree has a copious yellow exudate which the Waorani employ as face paint.

The resinous exudate of *Vismia ferruginea* HBK. is commonly applied to skin sores in the Brazilian Amazon (Schultes in prep).

Bixaceae

Bixa Orellana L., Sp. Pl. (1753) 512.
Collect.: Davis & Yost 1013.
Waorani Informant: Geque (m). Downriver dialect: n.v. *caca*

The aril around the seeds of this cultivated shrub is used as a bright red dye for pottery, blowguns and spears, as well as a face and body paint.

Elsewhere the root is considered to be an aid to digestion and the seeds an expectorant (Schultes in prep.) but the Waorani do not ingest the plant nor use it medicinally.

Violaceae

Leonia glycycarpa R. et P., Fl. Per. 2 (1799) 69.
Collect.: Davis & Yost 1022.
Waorani Informant: Cẹnto (m). Downriver dialect: n.v. *yẹmẹnca*

The cauliflorous fruits of this small forest tree are eaten.

Flacourticea

Carpotroche longifolia (Poepp.) Benth. in Journ. Linn. Soc. 5, Suppl. 2 (1861) 82.
Collect.: Davis & Yost 945.
Waorani Informant: Geque (m). Downriver dialect: n.v. *nonginca*

Waorani rub the cauliflorous fruits onto children to ensure long life.

In Colombia, the bark of *Carpotroche amazonica* Mart. is valued as a caustic (Altschul, 1973). In Brazil, the oil from the seeds of this tree is applied to treat dermatitis and leprosy (Usher 1974).

Casearia fasciculata (R. et P.) Sleumer in Notizbl. 11 (1934) 955.
Collect.: Davis & Yost 1033.
Waorani Informant: Cẹnto (m). Downriver dialect: n.v. *yẹpẹnẹ-moncawẹ*

The sweet fruits of this small tree are eaten by the Waorani.

Casearia prunifolia HBK., Nov. Gen. et Sp. 5 (1821) 362.
Collect.: Davis & Yost 1031.
Waorani Informant: Cẹnto (m). Downriver dialect: n.v. *yẹpẹnẹ-moncawẹ*

The Waorani eat the yellow fruits of this small tree, and Waorani hunters recognize that these fruits are eaten by many birds and small arboreal mammals. According to the hunters it is the favorite food of the tamarin (*Saguinus fuscicollis*).

In the upper Amazon of Brazil, the leaves of *Casearia ovata* Willd. are brewed in a tea for treating rheumatism. The fruit is diuretic (Schultes in prep.).

Mayna odorata Aubl. in Hist. Pl. Gui. Franç. 2 (1775) 921. t. 352.
Collect.: Davis & Yost 1047.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *bogi-moncamo*

The fruit of this small tree is edible.

Caricaceae

Carica Papaya L., Sp. Pl. (1753) 1036.
Collect.: Davis and Yost s.n.
n.v. *awanca*

The Waorani plant papayas in their gardens but recognize them as a recent introduction to the region.

Begoniaceae

Begonia sp.
Collect.: Davis & Yost 925.
Waorani Informant: Taade (m). Ridge dialect: n.v. *omencai.*

The succulent stems of this climber, which taste like rhubarb, are chewed as a condiment. Some Waorani suggest that it is good for colds.

Lecythidaceae

Gustavia longifolia Poepp. ex Berg in Martius, Fl. Bras. 14, pt. 1 (1859) 472.
Collect.: Davis & Yost 1017.
Waorani Informant: Cento (m). Downriver dialect: n.v. *nonginca*

The fruits of this 20 m. forest tree are eaten. The Waorani consider it to be one of the most beautiful trees of the forest and frequently plant it around house sites and clearings.

Grias cf. **Neuberthii** Macbr. in Field Mus. Nat. Hist., Bot. Ser. 11 (1931) 30.
Collect.: Davis & Yost 973.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *wingaca*

The cauliflorous fruits of this 30 m. forest tree are highly valued as an emergency food by all Waorani. During spearing raids, when chonta (*Bactris Gasipaes*) was out of season and the Waorani were forced to flee and live away from their gardens, they relied heavily upon this fruit.

Waorani hunters recognize that virtually all forest animals also eat it, including the spider monkey (*Ateles belzebuth*), squirrel monkey (*Saimiri sciurea*), woolly monkey (*Lagothrix lagotricha*) and both peccaries (*Tayassu pecari* and *T. tajacu*).

Myrtaceae

Calyptranthes plicata McVaugh in Field Mus. Nat. Hist. Bot. Ser. 13, pt. 4, no. 2 (1958) 607.
Collect.: Davis & Yost 944.
Waorani Informant: Geque (m). Downriver dialect: n.v. *cowa-dewę*

When ripe, the fruit of this 4 m. forest tree is valued as a food. It is also thrown into streams and back eddies to attract fish. Because the wood is extremely tough and can be hardened, it was cut with stone axes and fire-hardened to make hunting and raiding spears before the arrival of metal tools. It is still used in an emergency to improvise hunting spears.

Melastomataceae

Loreya collatata Wurdack in Phytologia 18 (1969) 162.
Collect.: Davis & Yost 937.
Waorani Informant: Geque (m). Downriver dialect: n.v. *titęmę-neca*

The fruit of this tall (30 m.) forest tree is eaten. The Waorani name, meaning "tapir's wild cacao", highlights recognition of the fact that the fallen fruits are browsed by tapir (*Tapirus terrestris*) and wild peccary (*Tayassu pecari, T. tajacu*).

Undetermined species of the Melastomataceae
Collect.: Davis & Yost 1036.
Waorani Informant: Cento (m). Downriver dialect: n.v. *ewɇngii*

The blue fruits of this common shrub are edible.

THEOPHRASTACEAE

Clavija sp.
Collect.: Davis & Yost 1055.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *namontaqui*

The beautiful aromatic flowers of this small shrub are prized and worn in coronas during festivals.

SAPOTACEAE

Undetermined specimen of the Sapotaceae
Collect.: Davis & Yost 1000.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *oopowɇ*

This primary forest canopy tree, which may attain a height of 80 m., has a delicious edible fruit. The orange-red fruits yield a copious white latex in the exocarp and have a sweet flesh surrounding the black seeds.

APOCYNACEAE

Undetermined specimen of the Apocynaceae
Collect.: Davis & Yost 955.
Waorani Informant: Geque (m). Downriver dialect: n.v. *wepɇ-monca*

The Waorani consume the fruits of this 25 m. tree and drink the copious latex which the fruit contains. They also recognize that all forest animals also eat the fruits.

Undetermined specimen of the Apocynaceae
Collect.: Davis & Yost 957
Waorani Informant: Geque (m). Downriver dialect: n.v. *cɇnɇiwɇ*

The copious white latex of this small forest tree is used by the Waorani to treat warble fly larvae (*Dermatobius hominus*) infes-

tations. The latex is rubbed over the area to suffocate and draw out the larvae.

The Waorani note that the scarlet macaw (*Ara macao* l) and the black hooded parrot (*Pionites melanocephala*) eat the fruit.

Convolvulaceae

Ipomoea Batatas (L.) Poir. in Lam. Encycl. 6 (1804) 14.
Collect.: Davis & Yost 1053.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *acagɨ*

The Waorani cultivate the sweet potato, often planting it around house sites. Although adults use it for variety in their diet, they do not rely heavily upon it. Children, however, frequently collect the tubers to boil or roast as snacks throughout the day.

Solanaceae

Brugmansia x **insignis** (Barb-Rodr.) Lockwood ex Davis, *comb. nov.*[1]
Basionym: *Datura insignis* Barb. Rodr. Vellosia, ed. 2, 1 62 1891.
Collect.: Davis & Yost 1054.
Waorani Informant: Tomo (m). Upriver dialect: n.v. no name given

Although this cultigen was found growing in a Waorani garden on a river flat, it was not recognized by the informants. The solitary specimen was the only representative observed in Waorani territory; it was probably dispersed by the river.

Many indigenous groups of eastern Ecuador use this plant as a powerful hallucinogen. The Kofan make an infusion of the leaves which they drink in shamanistic ritual. The indigenous groups of the Rio Pastaza region of Ecuador prepare a potion from the inner pulp to foresee the future. Elsewhere the leaves and sap of

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[1] Because of his untimely death, *Brugmansia* specialist Dr. Tommie E. Lockwood did not validly publish the combination *Brugmansia* x *insignis*. Lockwood did use this combination, however, in his account of *Brugmansia* for *Hortus Third* (Bailey and Bailey 1976) in which he explained the origin of this species as a hybrid between *B. suaveolens* (Humb. & Bonpl. ex Willd.) Bercht. et Presland and *B. versicolor* Lagerheim.

the plant are applied as a poultice to relieve aches and pains (Schultes in prep.).

Brunfelsia grandiflora D. Don *ssp.* **Schultesii** Plowman in Bot. Mus. Leafl. 23: 6 (197) 259.
Collect.: Davis & Yost 958.
Waorani Informant: Geque (m). Downriver dialect: n.v. *winę-męcawę*

The Waorani use the wood of this species in house construction. Although they recognize that the fruits are toxic, they do not use the plant medicinally or as a hallucinogen.

Brunfelsia grandiflora is one of the most prized medicinal plants of the Amazon. The Quichua name *chiricaspi* or *chiricsanago* means "cold tree" and "cold medicine", referring to its effect of producing the sensation of chills. Indigenous groups throughout the northwest Amazon use this plant to treat fevers.

It is also widely employed as an hallucinogen and is often added to narcotic drinks prepared from *Banisteriopsis Caapi*; it produces a tingling sensation in the extremities and intensifies the effects of the narcotic drink.

Preparations of the plant are also used to treat rheumatism and arthritis (Plowman 1977).

Capsicum chinense Jacq. in Hort. Vindob. 3 (1776) 38. t. 67.
Collect.: Davis & Yost 993.
Waorani Informant: Oncaye (f). Downriver dialect: n.v. *giimo*

The fruits of this cultivated pepper are used for stomachache. It is never eaten as food but is often used by the shaman's wife to bring him out of the intoxication induced by *Banisteriopsis muricata*.

Physalis angulata L., Sp. Pl. (1753) 183.
Collect.: Davis & Yost 995.
Waorani Informant: Oncaye (f). Downriver dialect: n.v. *cowane moncamo*

Children often eat the sweet fruits of this 1 m. tall plant that grows in exposed areas.

Solanum pectinatum Dunal in DC. Prod. 13, pt. 1 (1852) 250.
Collect.: Davis & Yost 930.
Waorani Informant: Taade (m). Ridge dialect: n.v. *daboca*

The Waorani consider this species wild and claim that it was planted by the jaguar. The pulp of the fruit is rubbed into the hair almost daily to give lustre and to control head lice. When eaten, the acidic fruits are said to be effective in preventing the vomiting that normally results from scorpion stings and bites. A decoction of the fruits is also rubbed on any type of sting.

Solanum sessiliflorum Dunal, Solan. Syn. (1816) 43.
Collect.: Davis & Yost 918.
Waorani Informant: Taade (m). Ridge dialect: n.v. *daboca*

The fruits of this cultivated shrub are eaten or sucked to relieve thirst. They are also rubbed into the scalp to make the hair shine. The pulp of the fruit is imbibed in cases of scorpion stings and spider bites to prevent vomiting, and the fruits are rubbed onto any type of insect sting or bite to alleviate pain.

Related species of *Solanum* are used in a variety of ways throughout the northwest Amazon. The Kofan use the pulp of a related species, *S. mammosum* L., to repel cockroaches. This practice is widely known, and it has been suggested that the insecticidal properties of the pulp and seeds should be investigated (Schultes 1982).

Bignoniaceae

Crescentia Cujete L. Sp. Pl. (1753) 626.
Collect.: Davis & Yost 1037.
Waorani Informant: Cẹnto (m). Downriver dialect: n.v. *owẹwẹ*

The fruits of this cultivated tree are used to make kapok (*Ceiba pentandra*) holders, drinking bowls and water containers, as well as the covers for the top and bottom of the dart quivers.

Mansoa Standleyi (Steyermark) Gentry.
Collect.: Davis & Yost 1035.
Waorani Informant: Cẹnto (m). Downriver dialect: n.v. *wiyagẹi*

The leaves and stems of this liana are extremely pungent, and the Waorani use them to treat fever, sore muscles and arthritic ailments. The leaves are crushed in hot water, and the decoction is drunk or applied topically to the afflicted area. When taken in large amounts, the decoction causes vomiting.

Minquartia guianensis Aubl. in Hist. Pl. Gui. Franç. 2 (1775) 4.
Collect.: Davis & Yost 1002.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *cobacadewẹ*

The bark of this 12 m. forest tree is stripped, pounded, and swished in water as a fish poison. The Waorani value the wood in house construction.

Acanthaceae

Ruellia colorata Baill. in Bull. Soc. Linn. Paris, 2 (1890) 853.
Collect.: Davis & Yost 1025.
Waorani Informant: Cento (m). Downriver dialect: n.v. *ẹwẹ-moya*

The bright, highly conspicuous inflorescences are placed as adornments in armbands during festivals.

Rubiaceae

Alibertia cf. **edulis** (L. Rich) A. Rich in Mem. Soc. Hist. Nat. Par. 5 (1830) 234. t. 21.
Collect.: Davis & Yost 1046.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *owẹcawẹ*

The Waorani employ the fruit of this small tree as a substitute for *Crescentia Cujete*. The fruit may be used as a bowl, a water container, to cover the dart quivers, or to carry kapok.

Calycophyllum acreanum Ducke in Archiv. Inst. Biol. Veg. Rio de Janeiro 2 (1935) 70.

Collect.: Davis & Yost 1041.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *ooyowɸ*

The bark of this 60 m. tree of the primary forest is shaved off to prepare a decoction for treating fungal infections.

Coussarea brevicaulis Karuase in Verh. Bot. Ver. Brand. 1903, 1 (1909) 117.
Collect.: Davis & Yost 936.
Waorani Informant: Geque (m). Downriver dialect: n.v. *omancomo*

The yellow fruits of this small tree are edible. The Waorani recognize that many animals also eat the fruit: especially the squirrel monkey (*Saimiri sciurea*), the pygmy marmoset (*Cebuella pygmeae*), the capuchin monkey (*Cebus albifrons*), the tamarin monkey (*Saguinus fuscicollis*), the red titi (*Callicebus moloch*), and the woolly monkey (*Lagothrix lagotricha*).

Duroia hirsuta K. Schum. in Mart., Fl. Bras. 6: 6 (1889) 367.
Collect.: Davis & Yost 966.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *owɸcawɸ*

This treelet is an abundant myrmecophyte of the primary rain forest. The Waorani break open the swollen stems that house the ants and apply the tissue and the concentrated pheromones directly to the inside of the cheek to relieve the pain that results from excessive use of the blowgun.

The Kofan use the leaves of an unidentified species of *Duroia* in a cold water infusion to treat coughs (Schultes in prep.).

Pentagonia parvifolia Steyerm. in Acta Biol. Venez. 4 (1964) 232.
Collect.: Davis & Yost 969.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *boyomo*

The Waorani eat the fruit of this 30 m. forest tree and report that all forest animals also consume the fruit.

The Kofan Indians take the pulp from around the seeds of an unidentified species of *Pentagonia* and place it in cuts to prevent infection (Schultes in prep.).

Pentagonia spathicalyx K. Schum. in Martius, Fl. Bras. 6, pt. 6 (1889) 302.
Collect.: Davis & Yost 942, 971.
Waorani Informant: Geque (m). Downriver dialect: n.v. *boyomo*

Known as *boyomo*, "the sting ray leaf" because the broad leaf looks like a sting ray, this forest tree gives an edible fruit applied to treat sting ray wounds—the most painful of all jungle afflictions.

Simira sp.
Collect.: Davis & Yost 1007.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *wepeta*

The bark of this tall (70 m.) forest tree oxidizes to a brilliant red and is used as a dye by the Waorani. Shavings are soaked overnight and boiled the next day to yield the red dye for infant-carrying slings, baskets, hammocks and fishnets.

Cucurbitaceae

Cayaponia Ruizii Cogn. in DC., Monog. Phan. 3 (1881) 794.
Collect.: Davis & Yost 959.
Waorani Informant: Geque (m). Downriver dialect: n.v. *cagiwɨnca*

The Waorani eat the seed of this liana, and hunters recognize that it is a preferred food of the toucan (*Ramphosto cuvieri*), the chestnut fronted macaw (*Ara severa*), the scarlet macaw (*Ara macao*), and the woolly monkey (*Lagothrix lagotricha*).

Although the Waorani do not consider this plant medicinal, the Kofan Indians burn the stems and apply the ashes of an unidentified species of Cayaponia to external sores to hasten healing (Schultes 1982). Indians of the Rio Apaporis in Colombia use the green bark of *Cayaponia ophthalmica* R.E. Schult. to prepare a wash to treat conjunctivitis. The Tikuna of the Rio Loretoyacu of Colombia dry and powder the leaves of *Cayaponia glandulosa* Cogn. to prepare an insect repellant for use in hammocks and clothes (Schultes in prep.).

Compositae

Clibadium asperum DC., Prodr. 5 (1836) 506.
Collect.: Davis & Yost 924.
Waorani Informant: Taade (m). Ridge dialect: n.v. *coonei*

The Waorani use the crushed leaves of this cultivated shrub as a very effective fish poison. Fifteen pounds of crushed leaves released into a stream 0.5 m. deep and 5 m. wide will stun the fish in a full kilometer downstream; when cast into a small oxbow lake, the plant material is effective for three to four hours. The Indians assert that this was not a fish poison of the ancestors, but that they received it from their neighbors, the Lowland Quichua.

This species is known throughout the northwest Amazon as a fish poison.

Family Undetermined

Collect.: Davis & Yost 950.
Waorani Informant: Geque (m). Downriver dialect: n.v. *mɇ-netadɇ*

This unidentified forest liana has a star-shaped fruit with yellow seeds covered by an orange aril. The latex of the stem is applied to the exposed nerve of a decayed tooth to deaden the pain.

Collect.: Davis & Yost 996.
Waorani Informant: Oncaye (f). Downriver dialect: n.v. *contaca*

The fruits of this 25 m. tree of the forest have a yellow rind and white flesh; the pulp is eaten.

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Collect.: Davis & Yost 1042.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *anawɇnta*

The Waorani shave the inner bark of this 60 m. forest tree and squeeze the shavings in water mixed with *Bixa Orellana* pulp to brighten the color from dull to bright orange.

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Collect.: Davis & Yost 1050.
Waorani Informant: Tomo (m). Upriver dialect: n.v. *quiguiwai*

The ancestors of the Waorani mixed various species of epiphytic bryophytes with *Dictyonema sp. nov.* (Davis 1051) to prepare an hallucinogenic drink. The generic terms for mosses is *quiguiwai.*

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UNIDENTIFIED WAORANI PLANT NAMES

a) *Dahɇtawɇ* — the bark of this tree is valued as a fungicide.
b) *Omeogo* — the inner cambium of this tree is harvested for bark cloth.
c) *Tanemo* — a liana that produces an edible tuber like the sweet potato.
d) *Titɇquewe* — The "wild" form of yuca used by the ancestors.
e) *Winca* — A shrub to small tree which is the source of a blue-black dye, similar to *Genipa* sp.

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PLATE 20

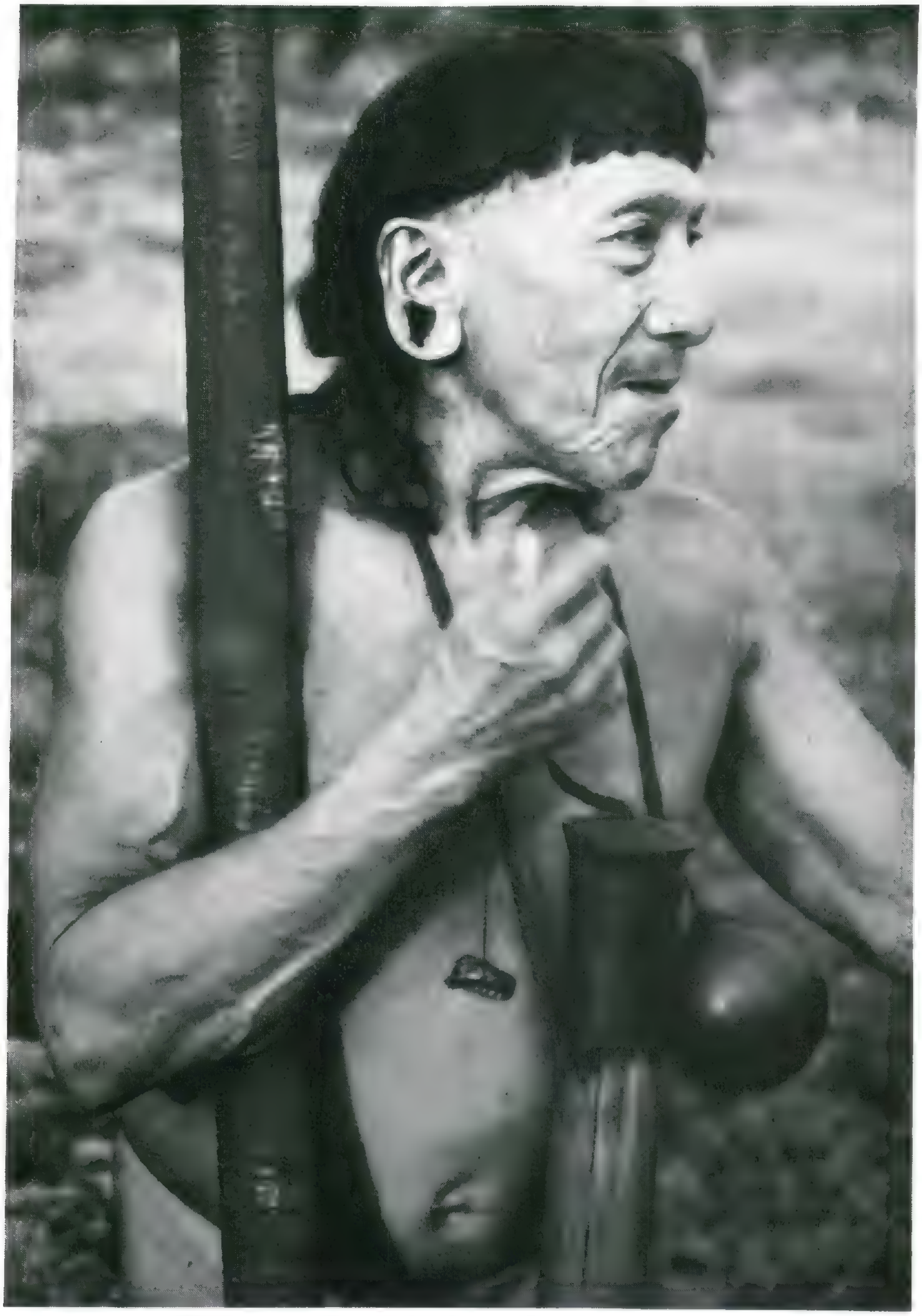

Plate 20. Waorani hunter, aged approximately 75. Note dart quiver, gourd containing kapok fiber, and piranha jaw for notching darts. Photograph by E.W. Davis.

PLATE 21

Plate 21. Fishing with méneco (*Lonchocarpus Nicou* (Aubl.) DC. var. *Urucu* Killip & Smith. Photograph by E.W. Davis.

PLATE 22

Plate 22. Treating one authors' infection with oonta (*Curarea tecunarum* Barn. et Druk.). Photograph by E.W. Davis.

PLATE 23

Plate 23. Kowé, Jaguar shaman drying the poison darts. To the left, supported by two hunting spears, is the filter for producing the poison. Photograph by E.W. Davis.

PLATE 24

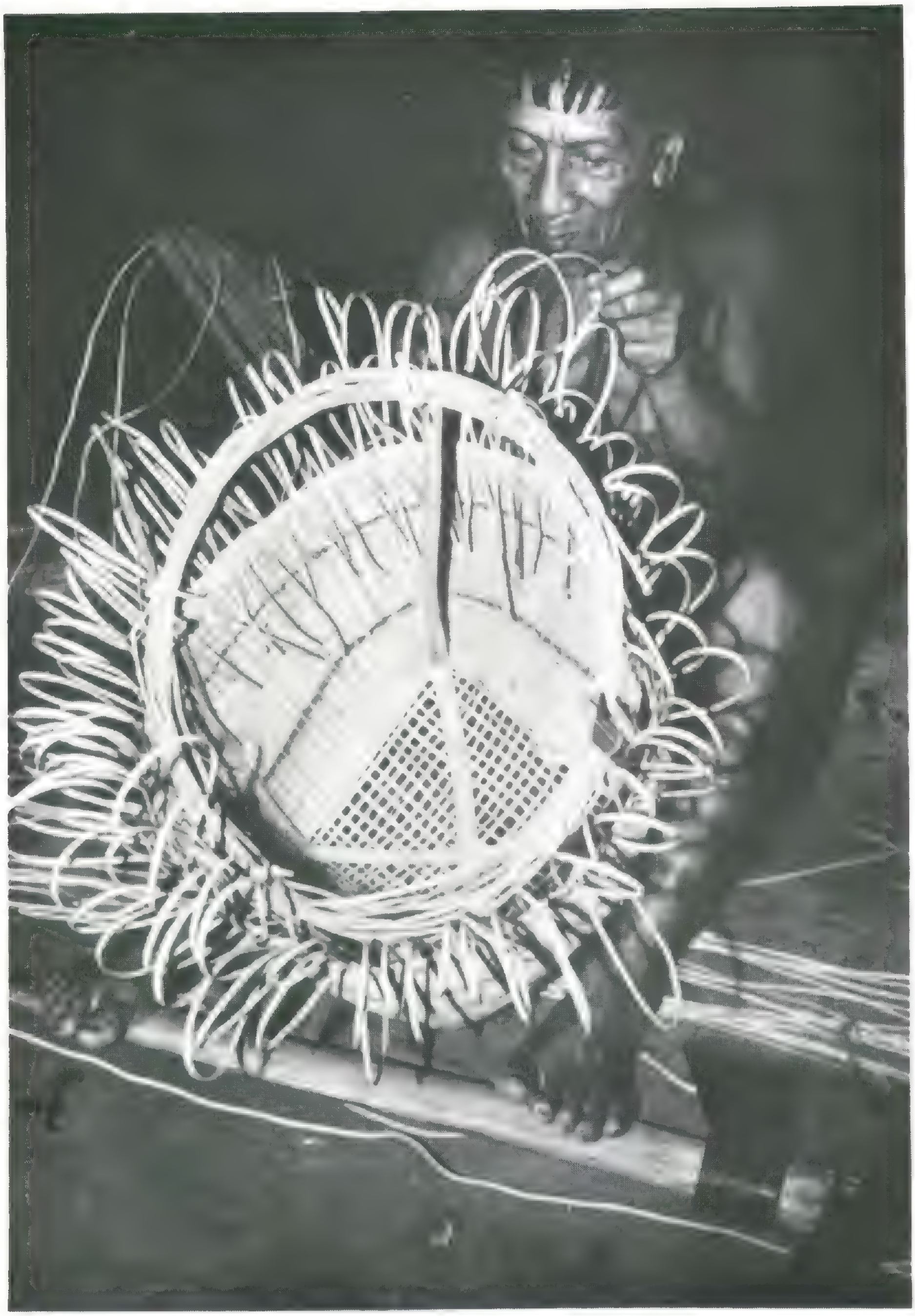

Plate 24. Weaving baskets with otame (*Heteropsis sp.*). Photograph by E.W. Davis.

PLATE 25

Plate 25. Weaving a hammock with chambira fiber (*Astrocaryum Chambira* Burret) Note the raw fiber on the ground. Photograph by E.W. Davis.

BOTANICAL MUSEUM LEAFLETS
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THE LAST MEAL OF THE BUDDHA

R. GORDON WASSON

I

WHAT WAS SŪKARA-MADDAVA?

Upwards of a dozen scholars[1] in the past century have commented on what the Buddha ate at his Last Meal, ca. B.C. 483, and the puzzling mystifications in the evidence. The meal was served to him and his suite of monks by his host the metalworker Cunda at Pāva, a village that lay near Kusinārā where the Mahāparinirvāṇa — the "Great Decease" as the Rhys Davidses translated it — was scheduled to take place some hours later. The canonical Pāli Text says that Cunda served his august guest *sūkara-maddava*, a hapax in Pāli. Walpola Rāhula, the Buddhist monk and scholar residing in the West, has assembled in a memorandum for us the relevant Pāli texts with his translations and notes, and his document is appended to our paper.

The first part of that compound word, *sūkara-*, is simple: "pertaining to swine," *sū-* being cognate with Latin *sus*. The second element is generally thought to mean tidbits, dainties, but whether as a specially delicate part of the pig's meat or as a food of which swine were specially fond, whether a subjective or objective genitive, no one can say. Rhys Davids, noticing that in Bihar there was a common edible underground fungus, translated *sūkara-maddava* by "truffles."[2] This was a successful pitch, considering that by "truffles" he meant an underground fungus common thereabouts, although no truffle (=*Tuber*) has been discovered so far in Bihar. His underground fungus was a *Scleroderma*, a little snow-white ball that is gathered just as soon as it appears on the surface. There are a number of genera of underground fungi of which truffles are one, and each genus has many species.

The two canonical Pāli Commentaries discuss but do not agree on the meaning to give to *sūkara-maddava*. One of them is the canonical Pāli Commentary on the *Dīgha Nikāya, Sumaṅgalavilāsini*, and the other, the *Paramatthajotikā*, the canonical Commentary on the *Udāna*. These Commentaries took their present form in Pāli under the guidance of the celebrated monk Buddhaghosa early in the fifth century of our era, mostly from Sinhala sources available to him. Each of these commentaries suggests various dishes as possibilities. Both include pork and an "elixir" (a chemical preparation) in the list of choices. The canonical Pāli Commentary on the *Dīgha Nikāya* adds soft rice with the broth of the five products of the cow. The canonical Pāli Commentary on the *Udāna*, deriving its authority from the Great Commentary (now lost) that dates from the third century B.C., offers two further choices: bamboo shoots (sprouts) trodden by pigs, and *mushrooms grown on a spot trodden by pigs*.

That the Buddha was eating his last meal was known to everyone thereabouts: nothing that happened there could have escaped those within eye-reach nor have been forgotten by them, not least because of the awesome event to take place a few hours later, the Buddha's translation to Nirvana that he had been predicting for that night since he was in Vai'sali three months before.

Dr. Stella Kramrisch, building on the work of the late Professor Roger Heim and me in eastern India, has identified with finality the *sūkara-maddava* as the *Pūtika*,[3] a plant that figures conspicuously in the Brāhmaṇas and other early post-Vedic sacred Sanskrit texts. In this paper I will examine the Last Meal at Pāvā and the death of Gautama the Buddha at Kusinārā in what is today northern Bihar. I will focus attention on what he ate at his Last Meal—a matter of little theological importance to the Theravadin branch of Buddhism and none at all to the Buddhists of the Greater Vehicle, but pertinent to our mushroomic inquiries and notably, as I shall show, to the identity of Soma.

Of all the scholars who have dealt with the Last Meal of the Buddha, I believe only one, André Bareau, has addressed himself to the surprising anomaly offered by the possibility of either pork or mushrooms being served to the Buddha at this meal. Here is what Bareau has to say:

> En effet, la viande de porc et plus encore les champignons sont des choses pour lesquelles les Indiens impregnés de culture brahmanique, comme l'étaient le Buddha et une grande partie de ses disciples, eprouvent un profond, un insurmontable dégout et que ne consomment guère que certains tribus sauvages ou des gens de basse caste, rejetés par la bonne société et pressés par la faim. L'idée d'offrir au Bienheureux, pour l'honorer et le régaler, comme un mets de choix,. . . .de la viande de porc ou des champignons est aussi insolite que si, dans une légende occidentale, on offrait à quelque éminent personnage un festin dont le plat principal serait une cuisse de chien ou une purée de goémon, des sauterelles frites ou des chenilles grillées; cela paraîtrait à juste titre une plaisanterie ou ferait croire à une erreur to copie. [*Recherches sur la biographie du Buddha*. Tome 1, p 267. Paris. 1970. Publications de l'Ecole Francaise d'Extrême-Orient, Vol LXXVII]

Confirming what Bareau says, Chap V-5 of the laws of Manu, believed to have been committed to writing around the beginning of the Christian era, declares that:

> garlic, leeks and onions, mushrooms and (all plants) springing from impure (substances), are unfit to be eaten by twice-born men,

and this proscription is repeated in V-19:

> A twice-born man who knowingly eats mushrooms, a village-pig, garlic, a village-cock, onions, or leeks, will become an outcast.

Here the prohibition carries a dire penalty. Mushrooms are forbidden in two further clauses, VI-14 and XI-156. The repeated prohibition applies expressly to twice-born men, which embraced the three upper castes.

The ban on mushrooms was no dead letter. Sir William Jones quotes from a commentator on the laws of Manu names Yama:

> . . .the ancient Hindus held the fungus in such detestation that Yama. . .declares "those who eat mushrooms, whether springing from the ground or growing on a tree, fully equal in guilt to the slayers of Bráhmens, and the most despicable of all deadly sinners." [*The Works of Sir William Jones*, Vol V, pp 160-161, London, 1807.]

This is the most extravagant outburst of mycophobia that we have found anywhere, surely the most extravagant to be found in the Indo-European world, which is saying a good deal. The learned Brahman tells us that the simple mushroom-eater is as bad as the murderers of Brahmans! Why such passionate, such exaggerated censure? Bareau, in comparing the Hindu eater of mushrooms to one among us who eats dog's flesh, was engaging in understatement.

* * *

Three months before the Last Meal at Pāvā and before his Mahāparinirvāṇa, the Buddha had been sojourning at Vai'sali and thereabouts. While in the vicinity of Vai'sali he had suffered a grave illness, attributed from ancient times to a chronic gastric upset, probably dysentery; had felt the weight of his years, had called himself an "octogenarian," and had announced his intention to go to Kusinārā and there three months later to experience the Mahāparinirvāṇa, the Final Extinction. He was predicting the time and place of his own end. He made his way to Kusinārā with his followers on foot, teaching the doctrine as was his wont, and it took him three months to cover the 140 kilometers. To his disciples and the villagers he made freely known his purpose: he never wavered in his resolution, not did he hide it from anyone.

The day before the Buddha reached Kusinārā he arrived at the nearby village of Pāvā and passed the night in the mango grove belonging to one Cunda, a metal-worker or blacksmith, and therefore a 'sudra, the lowest of the four castes in Hindu society. Cunda, appearing almost immediately, inquired what the Buddha desired. According to one of the Chinese recensions of the Buddha's life, the Buddha explained that he was to undergo the Mahāparinirvāṇa in Kusinārā: lamentations followed. Cunda invited the Buddha and his many followers to take their single meal the next day with him, and by his silence the Buddha accepted. Cunda withdrew to assemble the food and prepare it. In the morning Cunda came to summon the Buddha and his followers to the meal that he had prepared.

Cunda, as we said before, was a 'sudra, a man of the lowest caste. On the other hand, as the metal-worker of the region he was a technician, comfortably off, extending hospitality on a moment's notice to the Buddha and his numerous followers, one accustomed to meeting and mixing with travelers including individuals of what are today called the "scheduled castes," aboriginal tribesmen who were not Hindus and therefore not a part of the dominant Hindu society. His forge may well have been the *raison d'ẽtre* for Pāvā. When the Buddha arrived at Cunda's dwelling-place and was seated in the place prepared for him, he (according to the *Dīgha Nikāya*) addressed Cunda saying,

> As to the *sūkara-maddava* you have made ready, serve me with them, Cunda, and as to the other food, sweet rice and cakes, serve the monks with them. [Chap. IV, para. 18, p. 138]

The Buddha then said to Cunda,

> Whatever *sūkara-maddava* are left over to thee, those bury in a hole. [para. 19]

In a hole, not just throw away, and we are told that the surplus *sūkara-maddava* Cunda buried in a hole. Apparently Cunda had brought *sūkara-maddava* for the whole company, as he had thought all would share in them, so there must have been an ample surplus.

Then the Buddha added these remarkable words,

> I see no one, Cunda, on earth nor in Mara's heaven, nor in Brahma's heaven, no one among the Samaṇas and Brāhmaṇas, among gods, and men, by whom, when he has eaten it, that food can be properly assimilated, save by a *Tathāgata*. [para. 19]

Obviously the Buddha had recognized at once what he was being offered, the *sūkara-maddava*, and he knew the mushrooms were of a species that would shortly smell bad ("stink") if they were not eaten or buried in a hole. (To this day the custom

among some Santal seems to survive to bury any surplus *sūkara-maddava* in a hole.) Perhaps it was the first time in his life that the Buddha, of ksatriya origin, was being offered mushrooms to eat. But these particular mushrooms were familiar to him because of their unique role in the Hindu religion in which he had been brought up.

André Bareau appreciates to the full the solemnity of this dish of *sukara-maddava*, though he did not know what it was. He says:

> ...cette nourriture, la dernière que consomme la Bienheureux avant son Parinirvāṇa, est une nourriture en quelque sorte sacrée, dont les riches qualités, la puissance essentielle, vont lui permettre d'accomplir cet exploit surhumain, la suprême Extinction. Cette richesse, cette puissance sont trop grandes pour être supportées par les autre êtres, hommes ou dieux, qui n'auront jamais, et de loin, à exécuter une action comparable. [*Recherches sur la biographie du Buddha*. Tome 1, p 271. Paris. 1970. Publications de l'Ecole Française d'Extrême-Orient, Vol LXXVII]

Here was the Buddha, at one of the two supreme moments of his life, unexpectedly offered at his last meal a dish that Hindus of the upper castes were forbidden to eat, an edible mushroom, a dish that was the surrogate for Soma when formally sacrificed in an utterly different manner and setting[3]. Buddhaghoṣa quotes the Great Commentary (*Mahā-aṭṭhakathā*) as saying of Cunda's motives in offering this dish to the Buddha and his monks:

> They say that Cunda, the smith, having heard that the Exalted One would attain *parinibbāna* that day, thought it would be good if he could live longer after eating this dish, and offered it wishing for the Master's longevity. [p. 245 *infra*]

Walpola Rāhula's comment on the Great Commentary from which we have extracted this quotation is as follows:

> The *Mahā-aṭṭhakathā* (Great Commentary) is the most important of the ancient original Sinhala commentaries dating back at least to the 3rd century B.C., on which are based the present available Pāli commentaries of the 5th century A.C., including the Commentaries on the *Dīgha Nikāya* and the *Udāna* from which these two commentarial passages are taken. [p. 246 *infra*]

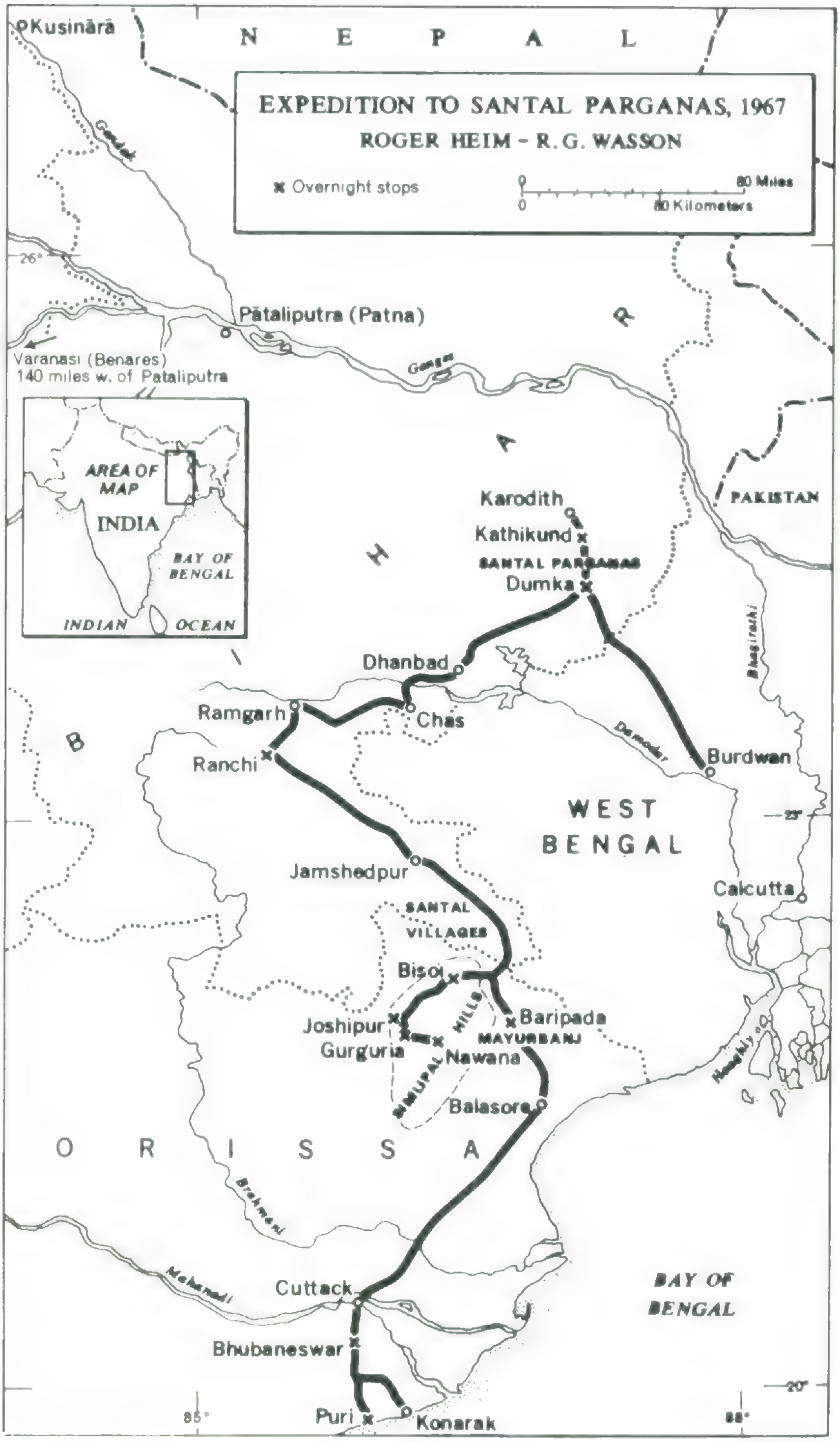
The Great Commentary cites hearsay ("They say...") as the reason that Cunda served those particular mushrooms on that day. The hearsay may be right, but if indeed Cunda felt the dish of *Pūtika* would extend the life of the Buddha, he must have confused the properties of *Soma* and of the *Pūtika*. The *Pūtika* enjoyed a unique status as the exalted surrogate for *Soma*, but, whereas *Soma* was consumed, the *Pūtika*, as Kramrisch quotes the sources,[3] were mixed with the clay and then fired ritually in the making of the Mahāvīra pot and there is no reason to think that the Hindus of the three upper castes or even the Brahman hierarchs ate these fungi. Does no the text of the Great Commentary permit another interpretation: Cunda, a 'sudra accustomed to eating the *Pūtika*, served them because it was the season of the rains (which had started when the Buddha and his suite were in Vai'sali) and the mushrooms, which he had known all his life, were fresh from picking? If so, it was the Buddha who at once recognized them because of their role in the Hindu religion and stopped Cunda from serving them to the others. The Buddha was certainly not accustomed to eating mushrooms of any kind, and here he was being invited to eat those slimy mucoid excrescences, as the twice-born Hindus with loathing would view them. May not this, combined with the emotional tension of his imminent extinction, have provoked a recrudescence of his intermittent attacks of dysentery?

I now interrupt our account of the Buddha's progress on his last day to set forth certain discoveries bearing on *sūkaramaddava*.

II

THE SANTAL AND THE *PUTKA*

By an accident of fortune the Santal people living now in western Bihar and Orissa have preserved for us, as though in a time capsule, the identity of the Sanskrit *Pūtika*, a plant until recently unidentified, an ingredient in the clay of the Mahāvīra vessel that was fired in the course of the Pravargya sacrifice. The *Pūtika* is known as having been the surrogate for Soma,[4] though probably today by no Santal, and it figures conspicuously in the


Kusinārā
N E P A L
EXPEDITION TO SANTAL PARGANAS, 1967
ROGER HEIM - R. G. WASSON
Overnight stops
0
80 Miles
0
80 Kilometers
Ganges
26°
Pātaliputra (Patna)
Varanasi (Benares)
140 miles w. of Pataliputra
AREA OF MAP
INDIA
BAY OF BENGAL
INDIAN OCEAN
Karodith
Kathikund
SANTAL PARGANAS
Dumka
PAKISTAN
Dhanbad
Ramgarh
Chas
Ranchi
Damodar
Burdwan
Bhagirathi
WEST BENGAL
25°
Jamshedpur
Calcutta
SANTAL VILLAGES
Bisoi
Joshipur
Gurguria
HILLS
Baripada
MAYURBANJ
SIMLIPAL
Nawana
Balasore
Hooghly
O R I S S A
Brahmani
Mahanadi
Cuttack
BAY OF BENGAL
Bhubaneswar
20°
85°
Puri
Konarak
88°

Brahmāṇas and other early sacred Sanskrit texts. As I said before, it was identified by Kramrisch on the strength of evidence produced by Heim and me.[5] (Roger Heim, oustanding French mycologist, had served as President of the Académie des Sciences and was Director of the Muséum National d'Histoire Naturelle: he accompanied me on many of my field trips.)

*

The late Georg Morgenstierne, the Norwegian linguist, specialist in the Kafir and Dardic languages, also a Sanskrit and Persian scholar, first called my attention to an oddity of the Santal language of special interest to me, as it affected their mushroom vocabulary. Santali was not a specialty of his but he was a vast reservoir of general linguistic knowledge.

The Santal, who number some millions, live in villages scattered in the area of eastern Bihar known as the Santal Parganas, in the western north-and-south strip of West Bengal, and in Orissa as far south as the Simlipal Hills. The Santal are slight in build, neat in dress, with sleek, black hair and dark almost black regular features, their houses of red earth ornamented with curious painted geometric patterns and neatly disposed within and without, in these respects contrasting with the Hindus. By tradition they are food gatherers, hunters, fishermen, but are now taking to agriculture. The languages of the subcontinent are divided into the Sanskrit family, overwhelmingly important, the Dravidian, second in importance, and the Munda, the third much smaller group of which Santali is the biggest. (I here do not mention the Sino-Tibetan languages, confined chiefly as they are to the northeastern border.)

From the Indo-European point of view, the Munda languages, of which Santali is the biggest member, are peculiar: in Santali there are no genders,—no msaculine, feminine, neuter. Their nouns are either animate or inanimate—endowed with a soul or without a soul. The entire animal kingdom is animate, has a soul. The whole of the mineral kingdom is inanimate, without a soul. There are oddities: e.g., the sun, moon, stars are animate. Strangely, the vegetable kingdom—herbs, shrubs, trees,

the fungal world—is inanimate, but *with a single exception*, one species of mushroom, the *putka*. The Santal do not know why the *putka* is animate, or so they say. The *putka* is an underground fungus that is gathered for eating just as it appears, a snow-white little ball, in mycology identifed by Heim as a Scleroderma, well known in Europe. In season it is highly prized as food by the Santal, and much sought for by women and children.

For the last century the Norwegian Lutherans have made a vigorous play to be helpful in India by missionary activity among the Santal. The Rev. P. O. Bodding, a resident of the Santal Parganas from 1890 to 1934, mastered their language and compiled an admirable Santal-English dictionary in five large volumes, pointing out among other things the oddity of *putka*, which enjoyed in the vegetable kingdom the unique attribute of a soul. He could not explain this anomaly, nor did he venture an etymology for *putka*. But in the preface to his dictionary Mr. Bodding observed a noteworthy fact:

> Strangely enough, the Santals use some pure Sanskrit words, which, so far as I know, are not heard in the present day Hindi.

I visited Dumka in the Santal Parganas for the first time in January 1965. The Rev. A.E. Strønstad, Mr. Bodding's successor, and Mrs. Strønstad put me up and Mrs. Strønstad graciously served as my interpreter. We asked elderly and knowledgeable Santal in Dumka and the surrounding villages why *putka* was animate. No one could tell us. Our best informant turned out to be Ludgi Marndi, the widow of a native Lutheran pastor. She told us that there was one entheogenic mushroom.* Was it the *putka*? No, not at all. It was merely *ot'*, "mushroom"

*"Entheogen" is a word devised by some of us for those plant substances that inspired Early Man with awe and reverence for their effect on him. By "Early Man" we mean mankind in prehistory or proto-history, before he could read and write, whether long long ago or since then or even living today in remote regions of the earth. "Entheogen" (or its adjective "entheogenic") has the advantage that it does not carry the odor of "hallucinogen," "psychedelic," "drug," etc. of the youth of the 1960's. See *Journal of Psychedelic Drugs*, Vol. 11 (1-2), Jan-June 1979, pp. 145-6.

of the soulless class. No one was able to find an example of this inebriating mushroom, but the description (big, growing only in dung mostly of cattle, and white reaching an intense cream color in the umbolate center) tallied with *Stropharia cubensis*. Neither were there any *putka* at the time of my visit: they would come after the monsoon broke. Ludgi Marndi and some other informants suggested that the *putka* was animate because it was found regularly in the sacred grove of *sarjom* trees near every village. (Santali *sarjom* = Hindi *sāl* = *Shorea robusta*.) But the sacred *sarjom* trees were not animate so why should a mushroom growing from their roots be? Furthermore, the *putka* grew also in mycorrhizal relationship with other species of trees. Ludgi Marndi seemed an especially good informant and just before we were leaving for New Delhi, defeated as we thought, I asked if I might talk with her again. We went over the same ground. Suddenly she leaned forward across the table to Mrs. Strønstad and in a whisper (as translated to me) said that she would tell her why she thought the *putka* were animate: "You must eat them within hours of gathering *for they will soon stink like a cadaver*." She spoke under considerable emotion. We knew not what this meant but at once I jotted down her translated words in my notebook and her remark appeared later, somewhat toned down, in the paper[6] that Heim and I published.

My 1965 visit was followed by another with Heim in July-August 1967, he flying from Paris to Calcutta and I from New York. We started our quest in the Simlipal Hills and the village of Bisoï in Orissa, where the Santal and their close linguistic kin the Ho intermix, as well as several other peoples. Again we questioned the natives about why the *putka* were animate. In Nawana in the Simlipal Hills I spent the evening with Ganesh Ram Ho, the chief of the village, and he, as Ludgi Marndi had done, voluntered the information that there was an entheogenic mushroom, and his description tallied with Ludgi's; his testimony confirmed that it was probably *Stropharia cubensis* or a close cousin. (That these two excellent informants volunteered to speak of an inebriating mushroom, doubtless *Stropharia cubensis*, is a lead not to be neglected: it may have played a part

in the cultural past of the Santal and of Soma.) But, just as before, it was "*ud*" and soulless. "*Ud*" is "mushroom" in Ho.

We published the account of our trips to the Santal country in *Les Cahiers du Pacifique*, #14, September 1970. Kramrisch in time saw our paper and she grasped immediately that the *putka* of the Santal was the *Pūtika* of the Brāhmaṇas, of the Pravargya sacrifice and the Mahāvīra pot.[3] The *Pūtika* had been the surrogate for Soma and naturally it would possess a soul! Kramrisch deserves a rich accolade for discovering that Santali *putka* was a loan word from the Sanskrit *Pūtika*. When Soma was being abandoned, probably over a long period that ended shortly after B.C. 1000, the *Pūtika* took its place, not as an entheogenic drink like Soma in the earlier sacrifice but as a component with the clay in the ceremonial firing of the Mahāvīra vessel. Its stench (of which Ludgi Marndi had spoken) was turned into fragrance when the pot, held by tongs, was fired in the course of the rite. No one had ever known what plant it was. We now know that, like Soma, it was a mushroom, but a common mushroom, and it possessed divine qualities though less than Soma's.

* * *

In Santal culture not only is the *putka* animate, endowed with a soul: it possesses another of Soma's attributes. The belief is apparently universal among the Santal that the *putka* is generated by (mythological) thunderbolts.[7] Long after the Brahmans have lost any use for or knowledge of this mushroom, and have lost all special contact with the Santal, these hunble, hardworking people, untouchables, still believe that the *putka* is procreated by the lightningbolt, as the Vedic Brahmans believed that Soma was procreated by the Vajra of Indra, or Parjanya, the god of lightning. Here is another manifestation, another proof, of the breathtaking cultural intensity millennia ago of the religion of the hierarchs of the Aryans. The lightningbolt was thought of as the sperm, the spunk, fecundating the soft mother earth with the entheogenic mushrooms.

The Santal believe there are two kinds of *putka*, the *hor putka* and the *seta putka*, one smooth and the other rough. Heim said the two kinds were merely different stages in the life cycle of the

one species. The *hor putka* is the "man *putka*," not in the sense of male but of a human being, or of the "Santal" whom they naturally regard as *par excellence* the human being. The *seta putka*, which is rough, is the "dog *putka*," the dog not being despised as it is in Hindu culture. A few of the Santal spoke to us of a third *putka*, the *rote putka* or "toad *putka*." Most Santal did not recognize this term and of those who did, most could not say what kind of mushroom it meant. But when we were in Kathikund, a village in the Santal Parganas, we witnessed from our veranda a violent midday thunderstorm and within hours and then throughout the night a host of puffballs appeared on the plain before our bungalow. One of our Santal companions told us with assurance that these were indeed *rote putka*. In this instance the puffball was *Lycoperdon pusillum* but probably any other puffball coming in response to a thunder shower would be a *rote putka*. In short, the *rote putka*, which is not eaten by the Santal, is a false *putka*. ...The entheogenic mushrooms of which Ludgi Marndi and Ganesh Ran Ho had told us, probably *Stropharia cubensis*, are not *putka*: they are mrely *ot'*, or *ud* in the Ho language, enjoy no grammatical distinction in the languages, and so far as I learned no distinction in folklore. But it is imperative that this be explored much further. Does its entheogenic virtue account for the colored geometrical designs, endlessly varied, that decorate the exteriors of many Santal houses?

*

Throughout our visits to the Santal country the people we spoke with said that pigs dug for the *putka*, thus confirming what the canonical Pāli Commentary on the *Udāna* says of *sūkara-maddava*. But I was seeking a quotation and after returning to New York the Rev. Johannes Gausdal, a retired missionary living in Oslo, put me in touch with Mr. Gora Tudu, principal of Kaerabani High School, and we asked Mr. Tudu through Mr. Gausdal whether swine sought out the *putka* in the forest. Here is what he replied:

> Whether the pigs eat *putka* or not? In this case also I got some *putka* from the forests. I tried them on a few pigs—the old *putka* were not liked, but the new ones seemed to be delicacies of the

> pigs. They ate them with relish. Also in the forest I found at several bushes where *putka* usually come up several marks of upturned earth, indicating that the pigs had been digging for the *putka*. [Letter in my *Munda* file]

I was careful not to divulge the reason this question was being asked. There are a number of genera of underground fungi divided among scores of species, and I should be surprised if they all drew pigs but perhaps they do.

Mr. Gausdal asked also about the smell of aging *putka*. Mr. Tudu replied, with unconscious humor:

> I collected some *putka*, both *hor putka* and *seta putka*, and put them in dishes in dry condition as well as wet, just to see what the smell would be like after decomposition. In both the smell emitted was that of decomposing wood material, not at all bad in the sense of any blooded being. The smell was never too strong or filthy. The worst I could compare, the smell was that of rotting jute in muddy water.

Kramrisch tells me that rotting jute in muddy water creates a fearful stench. Mr. Tudu possesses the endearing quality of dirt farmers everywhere: their fondness for the smell of dung heaps, for example, is powerfully colored by what dung means for the crops. The earthy smells of farm yards also possess a likeable integrity.

The Gausdal-Gora Tudu correspondence was conducted in Santali, but my questions and his answers to them were in English.

* * *

We know that the Santal have not always lived where they do now. Six hundred years ago they lived to the west of Benares on the Chotā Nāgpur plateau, and tradition has it that long before then the Santal had lived much further to the West, just where no one knows, but possibly near the ancient center of Brahmanical sacrifices, where they could have had close relations with the Aryans, perhaps serving them before and through the shift from Soma to the *Pūtika*. This would also explain the other Sanskrit words in Santali that Mr. Bodding notes. Indeed he remarks in

his preface to his Santal Dictionary that "the description of the Dasyus in the Vedas and the Mahābhārata seems to be adaptable to many a Santal."

III

THE DEATH OF THE BUDDHA

Having completed the Santal interpolation, we will now revert to the text of the *Dīgha Nikāya* as translated by the Rhys Davidses.

After the discussion of the *sūkara-maddava*, the Rhys Davids translation continues with an astonishing development:

> para. 20. Now when the Exalted One had eaten the rice prepared by Cunda, the worker in metals, there fell upon him a dire sickness, the disease of dysentery, and sharp pain came upon him, even unto death. But the Exalted One, mindful and self-possessed, bore it without complaint. [Chap. IV]

This was a disconcerting turn of events, since the Omniscient One has but lately said that he sees no one, save a Tathāgata, who can properly assimilate the *sūkara-maddava*, which he has just eaten. If the circumstances were invented, as Bareau thinks, what a strange set of circumstances for utterly devoted followers of the Buddha to have invented! The mushrooms, now that we know precisely, were sound and there was never a risk: moreover, aged *Pūtika* would declare their age by their stench! And Cunda was a responsible man to buy and cook them. However, let us remember that in the upper Hindu castes where the Buddha had been brought up and lived out all his early life, even though he was now free from food tabus and caste distinctions, all mushrooms would be shunned as inedible; but here, at a critical moment of his life, he was being offered *Pūtika*. Did Cunda know the role of the *Pūtika* in the religion of the twice-born castes? Did he perhaps know it by rumor, inaccurately? Or did he not know it at all and was he serving these mushrooms solely for the excellent reason that they were fresh and in season? It is clear from the testimony of the *Dīgha Nikāya* that the

attack suffered by the Buddha was sudden; it was violent; it alarmed the whole company; it was virtually over quickly, for not long afterward the Buddha instructed the faithful Ānanda that they should walk on to Kusinārā close by. But what could be more natural than a violent reaction in one brought up as a ksatriya to consider mushrooms inedible? And with his large intestine being chronically inflamed with dysentery, his diarrhoea was a natural sequence. "Dysentery" is a translation of the Pāli *lohita-pakkhandika*, which means "bloody flux" in old-fashioned English.

The account in the *Dīgha Nikāya* is as though written to order for this explanation. Two quatrains, apparently independent of each other, are inserted in the text of the *Dīgha Nikāya* (para. 20, p. 139) at this point. Buddhaghoṣa adds a note: "It should be understood that these are the verses by the Theras [Elders] who held the Council" the Council that took place at Rājagṛha, at which some months later the initial plans were laid for mobilizing detailed recollections of the Buddha's teachings and for organizaing the Buddhist religion. The first quatrain shows how those present murmured against Cunda, and, according to the second, there was also murmuring about the mushrooms. Here are the quatrains in the Rhys Davids translation:

> When he had eaten Cunda's food,
> The copper-smith's— thus have I heard
> He bore with fortitude the pain,
> The sharp pain even unto death.
>
> * * *
>
> When he had eaten, from the mushrooms [=*sūkara-maddava*]
> in the food
> There fell upon the Teacher sickness dire,
> Then after nature was relieved the Exalted One
> announced and said:
> I now am going on to Kusinārā.

After the episode the Exalted One went out of his way to exonerate Cunda of blame, thus making even more tenable my explanation of his illness. For if Cunda had been guilty of negli-

gence in choosing the mushrooms, why should the Omniscient One have exonerated him?

> 42. And the Exalted One addressed the venerable Ānanda, and said: 'Now it may happen, Ānanda, that some one should stir up remorse in Cunda the smith, by saying: "This is evil to thee, Cunda, and loss to thee in that when the Tathāgata had eaten his last meal from thy provision, then he died." Any such remorse, Ānanda, in Cunda the smith should be checked by saying:— "This is good to thee, Cunda, and gain to thee, in that when the Tathāgata had eaten his last meal from thy provision, then he died." From the very mouth of the Exalted One, Cunda, have I heard, from his own mouth have I received this saying:— "These two offerings of food are of equal fruit, and of equal profit and of much greater fruit and much greater profit than any other— and which are the two? The offering of food which, when a Tathāgata has eaten, he attains to supreme and perfect insight; and the offering of food which, when a Tathāgata has eaten, he passes away by that utter passing away in which nothing whatever remains behind these two offerings of food are of equal fruit and of equal profit, and of much greater fruit and much greater profit than any others. There has been laid up by Cunda the smith a karma redounding to length of life, redounding to good birth, redounding to good fortune, redounding to good fame, redounding to the inheritance of heaven, and of sovereign power." 'In this way, Ānanda, should be checked any remorse in Cunda the smith.' (p. 147-8)
>
> * * *

Bareau concedes that Cunda and Pāvā may be original elements but, if so, thinks that they are the sole original elements in the narrative of the Buddha's stay in Pāvā:

> Deux siècles après le Parinirvāṇa, ces deux noms, ici Pāvā et Cunda, étaient les deux seuls éléments anciens, peut-être même historiques, de l'épisode du dernier repas du Buddha. Aucun souvenier n'avait donc été conservé ni des incidents qui avaient pu s'y produire ni de la nature précise des aliments qui avaient été servis alors au Bienheureux. [Tome 1, p 258 in his *Recherches sur la biographie du Buddha*, Ecole Françcaise d'Extrême Orient]

Perhaps in the light of our discoveries Bareau may grant more to the history of the Buddha's Last Meal in Pāvā as told in the *Dīgha Nikāya*. Too many had witnessed the episode with the

mushrooms to permit the Theras to suppress it: his sudden illness had provoked too much talk.

* * *

Here is the account of the Buddha's death according to the *Dīgha Nikāya*, Chap. V.

1. Now the Exalted One addressed the venerable Ānanda, and said: 'Come, Ānanda, let us go on to the Sāla Grove of the Mallas, the Upavattana of Kusinārā, on the further side of the river Hiranyavatī.'

'Even so, lord!' said the venerable Ānanda, in assent, to the Exalted One.

And the Exalted One proceeded with a great company of brethren to the Sāla Grove of the Mallas, the Upavattana of Kusinārā, on the further side of the river Hiranyavatī: and when he had come there he addressed the venerable Ānanda, and said:

'Spread over for me, I pray you, Ānanda, the couch with its head to the north, between the twin Sāla trees. I am weary, Ānanda, and would lie down.'

'Even so, lord!' said the venerable Ānanda, in assent, to the Exalted One. And he spread a covering over the couch with its head to the north, between the twin Sāla trees. And the Exalted One laid himself down on his right side, with one leg resting on the other; and he was mindful and self-possessed.

In a note on this passage the Sinhala commentator added an explanation:

> Tradition says that there was a row of Sāla trees at the head of that couch, and another at its foot, one young Sāla tree being close to its head, and another close to its foot. The twin Sāla trees were so called because the two trees were equally grown in respect of the roots, trunks, branches, and leaves. There was a couch there in the park for the special use of the (periodically elected) chieftain of the Mallas, and it was this couch which the Exalted One asked Ānanda to make ready. (Ftnt. p. 149)

In the last watch of the night the Buddha died, precisely as he had been predicting for three months, since he was in Vai'sali.

There have been individuals in various parts of the world, and especially among the holy men of India, who have acquired by "concentration" (*samādhi*) control over some of the muscles that ordinarily function in response to stimuli beyond the human

will. A.L. Basham has remarked on this in *The Wonder That Was India*, p. 327:

> The ancient mystical physiology of India needs further study, not only by professional Indologists, but by open-minded biologists and psychologists, who may reveal the true secret of the yogī. For whatever we may think about his spiritual claims there is no doubt that the advanced yogī can hold his breath for very long periods without suffering injury, can control the rhythm of his own heart-beats, can withstand extremes of heat and cold, can remain healthy on a starvation diet, and, despite his austere and frugal life and his remarkable physical contortions, which would ruin the system of any ordinary man, can often survive to a very advanced age with full use of his faculties.

Basham fails to mention that occasionally death is the goal of this "concentration," but there is no reason to question that death can be the purpose of such an act of will. In recent years, when death has been the end result of this manifestation of will power, *mahāsamādhi* has sometimes been the term used when speaking of it.

The Buddha predicted the day of his death three months before and thenceforward announced freely the time and place of his own extinction. After his Last Meal the narrative says that on his initiative he walked the distance to Kusinārā. Since the time of his death, no Hindu, no Buddhist, has ever suggested that he died of mushroom poisoning. His death has not provoked discussion among Buddhists. Knowing as we now do what the mushrooms were that Cunda served, they could have provoked a stomach upset in a Hindu mycophobe but they could not have caused his death. He died of his own will power, of his own *māhasamādhi*. Or, rather than provoking his own death, did he not use yogic power, under trying circumstances, to postpose his translation to *nirvāna* until he had reached his place of choice?

* * *

The surrogate for Soma explains and justifies the extraordinary words used by the Buddha in limiting to himself alone this dish. By consigning to a hole the surplus *Pūtika*, he showed himself familiar with its everyday properties. Now that we know

the precise properties of this mushroom, its etymology as cognate with "putrid" is clarified,[3] and its strong link with Soma is a good explanation for the Santal belief that it is generated by the divine lightningbolt.

Up to this point we have concentrated on only one source the canonical Pāli Text of the *Dīgha Nikāya*—for our details about the life of Buddha. It is the Holy Scripture of the Theravadin branch of Buddhism with its headquarters in Sri Lanka. There are, in addition, five other master recensions of his life, four in Chinese and one in Sanskrit. All five mention the stop in Pāvā and name Cunda as the host there, but none of them mentions *sūkara-maddava*. An abvious explanation for this omission is that the Chinese are natural mycophiles: they eat with relish all kinds of edible mushrooms and they know their mushrooms. They would not understand why the Buddha honored the *Pūtika*, saying he alone could digest it. For the Chinese all this would have been incomprehensible.

The Buddha and his followers were mostly Hindus of the upper castes who had withdrawn from obedience to the Hindu religion. When the Theras assembled at Rajagṛja, they were inevitably, even if they were rebels, heirs to the infinite complexity of habits, practices, subtle ways of thinking and feeling of the Brahmanic religion. When Buddhism became a world religion, it liberated itself from the Brahmanic religion and this included the mightly tradition of Soma and the Vedic hymns, and of course from the less powerful hold of the *Pūtika*. In the early days of Christianity, before it became a world religion, the pull of Jewish ways such as circumcision and the ban on pig-meat exerted influence on Jewish converts to Christianity, and the early Church faced a parallel conflict.

IV

THE BUDDHA'S LAST MEAL

The episode at Pāvā lends itself to various explanations; the written record contains a number of anomalies. If we were to offer the solution that we think is most likely, here it is.

There is only the Commentary on the *Udāna*, which Buddhaghoṣa presented as hearsay, to show that Cunda the 'sudra knew of the use made by the Brahmans of the *Pūtika*. Cunda certainly knew this mushroom as a universal favorite among mushroom eaters when it was in season and it was in season right then: he was taken aback when the Buddha recognized the mushroom and asked him, in astonishing language unfamiliar to his ears, to serve them to the Buddha only. Cunda had done himself proud in assembling mushrooms for the whole company, and now he was forbidden to give them to the guests or even to himself.

Shortly after the Buddha had eaten his mushrooms with rice he fell violently ill. This must have caused Cunda consternation and chagrin. Alarm was felt, and there was murmuring against Cunda and the mushrooms in the assembly, for all or almost all were twice-born men and had been indoctrinated against mushrooms. We can imagine Cunda's embarrassment but we have no information: an opaque cloud of silence falls over him.

In the *Dīgha Nikāya* the Buddha exonerates Cunda, somewhat stiltedly under the circumstances. Perhaps everyone remembered that the Buddha had spoken up for Cunda and many had heard him but none could recall what precisely he had said. Someone seems to have drafted the paragraph much later. The fitting exoneration of Cunda demonstrated the thoughtfulness and the nobility of the Buddha under most trying circumstances.

Was not "*sūkara-maddava*" introduced in place of *Pūtika* at Rājagṛha to avoid confusing people as to the Buddha's attitude toward the Old Religion? He showed an attitude toward the *Pūtika*, and he reacted to them, in a way that we today, under the circumstances, can understand for the first time.

And as for the diverse explanations in the two canonical Commentaries for *Sūkara-maddava*, they may have been introduced at Rājaghṛa also, or perhaps more likely late in Ashoka's reign when the need for an explanation became increasingly felt by the Buddhist community. No theological importance was ever given, then or later, to the Pāvā episode because, after all, the Buddha was under acute stress at the time, what with his illness, his imminent extinction freely predicted since he was in

Vai'sali three months before the episode at Pāvā, and the unexpected dish of *Pūtika* that suddenly confronted him. There had been far too much talk among those present to suppress the episode, but obviously the *Pūtika* was not to be identified plainly. The *sūkara-maddava* was a way to tell the truth but still to interpose obstacles to its understanding. The word may have been a neologism invented *ad hoc*.

Now we see for the first time in how dramatic a predicament the Brahman proscription on mushrooms for the twice-born castes accidentally involved the Buddhist religion at the very moment of its birth. We still do not know – we will probably never know— when that proscription came into force, perhaps over centuries while the Vedic hymns were being composed, or possibly when the hierarchs among the Brahmans learned of the entheogenic virtues of *Stropharia cubensis* as known to the lower orders living in India, or when Soma was finally abandoned and the *Pūtika* adopted as its surrogate. But we do know how effectively the Buddhist Theras fudged the facts in the *Dīgha Nikāya*, until an inquirer 2,500 years after the event appeared, assembled the evidence, and with the help of Georg Morgenstierne, Roger Heim, Stella Kramrisch, Wendy Doniger O'Flaherty, and above all of the Santal people, fitted together the jigsaw pieces.

V

THE INDUS VALLEY AND KASHMIR

When we published *SOMA Divine Mushroom of Immortality* in 1968 I pointed out in it that in the 1028 hymns of the RgVeda there was never a mention of the blossoms, fruit, seed, leaves, branches, bark, or roots of the plant—a telling clue where to look for the divine herb. But there was another botanical fact that deserved full recognition, but I had not yet focused on it.

Botanists divide plants between phanerogams and cryptogams. The phanerogams include all flower- and seed-bearing plants, whether trees, shrubs, creepers or climbers, herbs and

grasses, whether cultivated or uncultivated. The cryptogams are lower orders of vegetation, less developed along the evolutionary trail, and the mushrooms are the cryptogams that interest us. Only in recent centuries have three or four species out of thousands lent themselves to commercial exploitation, and a meager handful also to expensive cultivation in laboratories. In Aryan times, in the Indus Valley and Kashmir, there was the widest variety of climate, owing to the variety of accidented terrain therein—lofty mountains, low lying plains, valleys, wetlands, arid stretches and any needed phanerogam could probably have been grown in some part of that large country. *But only those mushrooms grew there that the country produced spontaneously*. Since we know that the supply of Soma was limited at best to the mountains and must have been further reduced when the monsoon failed, conforming to what we know about Soma in Vedic times, this points to the entheogenic mushroom *Amanita muscaria* for their Soma. That the birch and also the conifers act as hosts to *A. muscaria* was not realized by anyone among the Aryans, and therefore no one thought of planting the host trees to see whether by this means man could thus increase the yield of the holy plant.

Other fungal entheogens grow at the lower levels. They come in cattle dung, are easily identified and gathered, and are effective. But they fail to conform to Brahman practices: they are known to tribals and 'sudras. Soma on the other hand exacts self-discipline of the priests, a long initiation and training: it is, for proper exploitation, an affair of a priestly *élite*. But the possible role of *Stropharia cubensis* growing in the dung of cattle in the lives of the lower orders remains to this day wholly unexplored. Is *S. cubensis* responsible for the elevation of the cow to a sacred status? And for the inclusion of the urine and dung of cows in the *pañcagavya*? And was that a contributing reason for abandoning Soma? Given the ecological conditions prevailing in the Indus Valley and Kashmir, only a few of the Aryans could know by personal experience the secrets of the Divine Herb. The cult of Soma must have been shaped by the

peculiar circumstances prevailing in the area, but ultimately those circumstances must have doomed that cult. Today it lives on in India only as an intense and glowing memory of an ancient rite.

Under the British Raj the rich and diverse vegetation of India was admirably studied, and George Watt's encyclopaedia *Dictionary of the Economic Products of India*, 1889-1896, in eleven volumes, edited and partly written by him, is a major legacy of the British rule in India. However, the mycophobic British did little to advance knowledge of mycology, and the Hindus nothing. No one ever suggested a mushroom for Soma, let alone *A. muscaria*. Our *SOMA* came out in 1968 but no *A. muscaria* since then has yet been found in Pakistan or Kashmir: there have been numerous reports of finds but voucher specimens have not been deposited in herbaria. Dr. Roy Watling, mycologist of the Royal Botanic Garden of Edinburgh, spent three weeks in the field in 1978 on a general survey of the Kashmir area, in the vicinity of Srinagar. He collected in stands of birch in two areas but he arrived there late in the growing season and moreover the season was dry. In his printed report[8] he writes, "The species *A. muscaria* is almost certainly native to the *Betula*-zone of northern India." There he found *Betula utilis* from 9,000 feet up to the timber line at 10,500 feet but no *A. muscaria*. In the Northwestern Himalayas the birch grows intermixed with Rhododendron in scrub-vegetation up to 11,500 feet.

We may think we are feeling the frustrations of the Aryans but by comparison with them we are making only lackadaisical efforts to find a few voucher specimens, whereas the Brahmans must have developed urgent need for quantities of fruiting bodies to dry, and then to reflate, and bring to the pressing stones. Their needs must have been constantly increasing with the increasing population. Whatever may have been the case later, the relations at first with the natives were surely hostile. The natives seem to have come to occupy the intermediate mountain heights, precisely where *A. muscaria* grows and where the Ṛgveda time and again says Soma grows. As we know from the *'Satapatha Brāhmaṇa*, the Brahmans depended for their

Soma supplies, in large part at least, on the natives living in the mountains. The supply depended on the weather and the state of the relations with the natives, whereas the needs were swelling with every generation. The Brahmans must have found it in their interest to cultivate the Dasyus and the Dasyus would have found it advantageous to discover every spot where *A. muscaria* grew, above all the stands of birch but also other host trees. (*A. muscaria* has been reported lately from Tamilnadu, especially from the Nilgiri Hills, in Southern India, but its presence there has been attributed by mycologists to plantings of exotic conifers in the past century.) Most of the Soma sacrifices must have used make-do phanerogamic subtitutes and in the post-Vedic Brāhmaṇas and other writings we learn how the priests from early times faced this scarcity with such make-do plants.

The Brahmans probably continued to trade with the mountains of Afghanistan seeking Soma, and with the Hindu Kush, but there is no knowing whether these tribesmen were friendly, perhaps intermittently. The *Afghanistan Journal* 6.2 1979 announced the finding of *A. muscaria* in Nuristan, in the Shetul Valley high in the Hindu Kush in the extreme northeast of the country. The authors, Gholam Mochtar and Hartmut Geerken of Kabul, talked with three old codgers, ostensibly *habitués* of the "ravens' bread," claimed to be *A. muscaria* from which an inebriating concoction is made. The episode is insufficiently documented to permit conclusions about its bearing on *Amanita muscaria* and the Soma questions. Their report antedates the Russian invasion.

The use of substitutes by the Aryans must have been a reluctantly adopted practice from the start. They are mentioned for the first time in the last batch of hymns incorporated into the canon, Mandala X 85 through to the end, 191. In *SOMA* we failed to take into consideration these hymns of Mandala X, since they were admitted to the canon at a late stage, shortly before the Vedic age ended. But some years ago Professor Clifford Wright, in a lecture delivered at Cambridge University, took the position that many of those hymns, the last to be admitted to the canon, on strong stylistic grounds were by no means

the last to be composed. There is a verse in these hymns that speaks of the substitutes. That hymn may well have been composed centuries earlier:

> RgVeda X 85.3: One thinks one drinks Soma because a plant is crushed.
> The Soma that the Brahmans know
> that no one drinks.

This conforms to our present thinking: the scarcity of Soma was not to be explained by the spread of the Aryans southward, then eastward down the Yamunā and beyond the confluence with the Ganges. The scarcity had always existed, and the make-do substitutes had been a chronic problem.

MEMORANDUM BY WALPOLA RĀHULA OF THE EARLY SOURCES FOR THE MEANING OF *SŪKARAMADDAVA*

SŪKARAMADDAVA

The original Canonical Pali passage from the *Mahāparinibbānasutta* of the *Dīghanikāya*, Pali Text Society edition (London 1966), Vol. II, p. 127:

> Atha kho Cundo kammāraputto tassā rattigyā accayena sake nivesane paṇītaṃ khādaniyaṃ bhojaniyaṃ paṭiyādāpetvā pahūtañ ca sūkaramaddavaṃ Bhagavato kālaṃ ārocāpesi: 'Kālo bhante, niṭṭhitaṃ bhattan'ti.

Translation:

> Then at the end of that night, Cunda, the smith, having made ready in his house hard and soft delicious food, and also a big quantity of *Sūkaramaddava*, announced the time to the Exalted One, saying: 'The time, Lord, has come, the meal is ready.'

In explaining *sūkaramaddava* in this passage the Pali Commentary of the *Dīghanikāya*, *sumaṅgalavilāsini*, Pali Text Society ed. (London 1971), Vol. II, p. 568, gives three different opinions:

Sūkaramaddavan ti n'ātitaruṇassa n'ātijiṇṇassa ekajeṭṭhakasūkarassa pavattamaṃsaṃ. Taṃ kira muduñ c'eva siniddhañ ca hoti. Taṃ paṭiyādāpetvā sādhukaṃ pacāpetvā'ti attho. (Colombo ed. of the *Sumaṅgalavilā*sini, Part I, (1918) p. 395 adds within brackets): [Eke bhaṇanti: sūkaramaddavaṃ pana muduodanassa pañcagorasa—yūsapācanavidhānassa nāmam etan'ti yathā gavapāṇaṃ nāma pākanāmaṃ. Keci bhaṇanti: sūkaramaddavaṃ nāma rasāyaṇavidhi, taṃ pana rasāyaṇasatthe āgacchati, taṃ Cundena Bhagavato parinibbānaṃ na bhaveyyā'ti rasāyanaṃ paṭiyattan'ti.]

Translation:

> *Sūkaramaddava* means meat available (in the market) of an excellent (first-rate) pig neither too young nor too old. This is soft and fatty. 'Having made it ready': having cooked it well is the sense. (Some say: *sūkaramaddava* is the name for a culinary preparation of soft rice made into a broth with the five products of the cow[1], just as *gavapāna* is the name of a culinary preparation. Others say: *sūkaramaddava* is a chemical preparation [elixir]. It is found in the science of chemistry. That chemical preparation [elixir] was made by Cunda thinking that the *parinibbāna* of the Exalted One might not take place.)

The story of Cunda offering *sūkaramaddava* to the Buddha occurs exactly in the same way in another canonical Pali text, *Udāna*. The *Paramatthajotikā*, Commentary on the *Udāna* (Colombo 1920), p. 279, in explaining *sūkaramaddava* gives four different opinions:

> Sūkaramaddavan'ti sūkarassa mudusiniddham pavattamaṃsan'ti *Mahāaṭṭhakathāyaṃ* vuttaṃ. Keci pana sūkaramaddavan'ti na sūkaramaṃsaṃ, sūkarehi maditavaṃsakaḷiro'ti vadanti. Aññe: sūkarehi madditappadese jātaṃ ahicchattan'ti. Apare pana sūkaramaddavaṃ nāma ekaṃ rasāyanan'ti bhaṇimsu. Tañ hi Cundo kammāraputto ajja Bhagavā parinibbāyissati'ti sutvā 'appeva nāma naṃ paribhuñjitvā cirataraṃ tiṭṭheyyā'ti Satthu cirajīvitukamyatāya adāsi'ti vadanti.

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1. Five products of the cow: 1) milk, 2) curd, 3) buttermilk, 4) fresh butter 5) clarified butter (ghee). W.R. [Walpola Rāhula is a Buddhist monk of our day and he renders in English the Sanskrit word *pañcagavya* as befits our times. In the past, for millennia *pañcagavya* represented: 1) milk, 2) coagulated or sour milk, 3) butter, 4) urine, and 5) dung. R.G.W.]

Translation:

It is said in the Great Commentary (*Mahāaṭṭhakathā*)[2] that *sūkaramaddava* is soft and fatty pork (flesh of pig) available (in the market). But some say: *sūkaramaddava* does not mean pork (flesh of pig), but bamboo shoot (bamboo sprout) trodden by pigs; others say that it is mushroom grown on a spot trodden by pigs; still others have maintained that *sūkaramaddava* is a certain elixir. They say that Cunda, the smith, having heard that the Exalted One would attain *parinibbāna* that day (lit., today) thought that it would be good if He could live longer after eating this (preparation), and offered it wishing the Master's longevity.

EPILOGUE

When I began working with Gordon Wasson on *SOMA*, almost twenty years ago, we had, at first, no suspicion that Soma might have been a mushroom: we just wished to collect the texts relating to Soma and look at them with a botanical as well as an Indological eye. It was only when I casually mentioned to RGW the urine-drinking, Soma-drinking episode in the *Māhabhārata* that he thought of *Amanita muscaria* as a possible identity for Soma, but from that moment on he became increasingly convinced that this was the case. I was certain that the evidence proved Soma was an entheogen (we called it an hallucinogen then), and that it was not a form of alcohol (as had been theretofore widely believed) but was a drug provoking an ecstasy of a very special kind. Here is a truth of great importance in the study of later Indian religion and this was the major contribution that RGW had made to Vedic studies.

I was, however, not yet convinced that Soma was a mushroom. I felt that the arguments rested primarily on the interpretation of adjectives, many of them words for colors, and mythological traits, many of which applied to other gods as well,

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2. The *Mahāaṭṭhakathā* (Great Commentary) is the most important of the ancient original Sinhala commentaries dating back at least to the 3rd century B.C., on which are based the present available Pāli commentaries of the 5th century A.C., including the Commentaries on the *Dīghanikāya* and the *Udāna* from which these two commentarial passages are taken. W.R.

permitting other interpretations as well as the interpretation that identified Soma with the fly-agaric. As an Indologist, rather than a botanist, I still feel that the broader hypothesis—that Soma was an entheogen is more significant than the narrower one— that it was a mushroom. Over the years, however, the new evidence that RGW has brought to light, particularly the evidence linking the Buddha's last meal to Soma through the double links of the Vedic *Putika* and the Santal *putka*, does in fact make it seem likely that Soma was a mushroom, as RGW believed from the first moment, and, when we recall the religious role of urine mentioned above, specifically the fly-agaric. But each of the three levels of the hypothesis—that Soma was an entheogen, a mushroom, and the fly-agaric—adds valuable dimensions to our understanding of both Vedic and post-Vedic religion.

Wendy Doniger O'Flaherty

Chicago
January 15, 1982

NOTES

1. 1896 and earlier, Karl Eugen Newmann: *Die Reden Gotamo Buddho's aus des Mittleren Sammlung Majjhimanikāyo des Pāli-Kanons*, Leipsig, 1896, pp. xix-xxii. Neumann cites earlier writers: Friedrich Zimmermann, who in turn refers to an article in the *Journal of the Maha-Bodhi Society*, Vol. 1, No. viii, pp. 2-3, Calcutta, 1892, wherein the editor of this *Journal* reproduces statements by "Rhys Davids, Bigandet, Rockhill, and Colonel Olcott," laying stress on the proper meaning of *sūkara-maddava*. We have seen none of these earlier discussions.

1910. T. W. and C. A. F. Rhys Davids, and later editions. *Dialogues of the Buddha: Part II*. Translated from the Pāli of the *Dīgha Nikāya* by T. W. and C. A. F. Rhys Davids. One of the series of the Sacred Books of the Buddhists. Published for the Pāli Text Society by Luzac, London. (All of our quotations from the *Dīgha Nikāya* are from the 1959 edition.)

1916. Coomaraswamy, Ananda K.: *Buddha and the Gospel of Buddhism*. p. 79., George G. Harrap, London.

1931-2. Arthur Waley. "Did Buddha die of eating pork?" *Mélanges chinois et bouddhiques*, Vol. 1., pp. 343-354. Brussels.

1942. Fa Chow. "Sūkara—maddava and the Buddha's Death." *Annals of the Bhandarkar Oriental Research Institute.* Edited by R. N. Dandekar, pp. 127-133.

1948. E. Waldschmidt. *Beiträge zur Textgeschichte des Mahāparinirvānasutrā*, pp. 63-85: "Die Letzte Mahlzeit des Buddha."

1948. E. J. Thomas. *Indian Culture*, XV, pp. 1-3: "Buddha's Last Meal."

1949. A. Foucher. *La Vie du Bouddha.* Paris, Payot, pp. 304-308: "Le Dernier repas à Pāvā."

1968. André Bareau. "La Nourriture offerte au Buddha lors de son dernier repas," *Mélanges d'Indianisme*, Paris, Editions E. de Boccard, pp. 61-71.

1970. André Bareau. *Recherches sur la biographie du Buddha.* Tome I. Notably Chapter VII 8 & 9, pp. 251-281. Paris. Ecole Françcaise d'Extrême-Orient, Vol. LXXVII.

1970. P. Demiéville. Review of R. Gordon Wasson: *SOMA: Divine Mushroom of Immortality. T'oung Pao*, LVI: Livr. 4-5, pp. 298-302. E.J. Brill, Leiden.

This list does not pretend to be exhaustive.

2. See note 1, entry under 1910, p. 137 ftnt.

3. Stella Kramrisch: "The Māhavira Vessel and the Plant Pūtika," *JAOS*, 95.2, April-June 1975.

4. See Manfred Mayrhofer: *A Concise Sanskrit Etymological Dictionary*, entry under *pūtikah*, also Vol. 3, p. 761.

5. *Cahiers du Pacifique* #14, September 1970: "Les putka des Santals, champignons doués d'une âme." p. 77. For those interested, the mushroom was *Scleroderma hydrometrica* (Pers.) H. var. *maculata* (Pat.) H. In Europe it breaks out into an Astraeus, but in India remains closed, a Scleroderma.

6. *Idem*, p. 65.

7. *Idem*, p. 64 bottom of page; *SOMA: Divine Mushroom of Immortality*, pp. 39-40.

8. Watling, Roy and Norman M. Gregory: "Larger Fungi from Kashmir," *Nova Hedwigia*, Band XXXII, Brunswick, 1980, J. Cramer.

For those interested in our side of the controversy over Soma, we list the following items as essential:

1. *SOMA: Divine Mushroom of Immortality*, by R. Gordon Wasson and Wendy Doniger O'Flaherty. 1968. Harcourt Brace Jovanovich, Inc., New York.

2. "Les putka des Santals, champignons doués d'une âme," by Roger Heim and R. Gordon Wasson. September 1970. *Cahiers du Pacifique* #14, pp. 60-85. With 11 plates, 5 in color; 5 figures and one map in text.

3. "The Soma of the RigVeda: What Was It?" *Journal of the American Oriental Society*, Vol. 91, No. 2, April-June 1971, pp. 169-187. Published along with Daniel H. H. Ingalls, Wales Professor of Sanskrit, Harvard University: "Remarks on Mr. Wasson's *SOMA*" in the same issue of the *Journal*. Both papers were reprinted by the American Oriental Society as No. 7 in their Essay Series with an introduction by Ernest Bender, Editor of the *Journal*.) Translated into Spanish and published in *Plural*, Mexico City, in Jan.-Feb. issues, 1976.

4. *Soma and the Fly-agaric: Mr. Wasson's Rejoinder to Professor Brough*, by R. Gordon Wasson. Nov. 1972. Botanical Museum of Harvard University. Cambridge, Mass.

5. "The Mahāvira Vessel and the Plant Pūtika," by Stella Kramrisch. *Journal of the American Oriental Society*, Vol. 95.2, 1975. pp. 222-235.

6. "*SOMA* Brought Up-to-date," by R. Gordon Wasson. *JAOS* 99.1, 1979. Also appeared afterward in the *Botanical Museum Leaflets*, Vol. 26, No. 6.

7. "The Last Meal of the Buddha," by R. Gordon Wasson, with "Epilogue" by Wendy Doniger O'Flaherty, *JAOS* 102.4, 1982.

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DE PLANTIS TOXICARIIS E MUNDO NOVO TROPICALE COMMENTATIONES XXXII

NOTES, PRIMARILY OF FIELD TESTS AND NATIVE NOMENCLATURE, ON BIODYNAMIC PLANTS OF THE NORTHWEST AMAZON

RICHARD EVANS SCHULTES

Field work to salvage ethnobotanical knowledge in the northwest Amazon has not been commensurable with the rapidity of the disappearance of this folklore as a result of growing acculturation. Many native languages of the region are becoming extinct, and the natives, knowing no Spanish names for their plants, are losing even their acquaintance with the local flora. This paper, a continuation of numerous ethnobotanical contributions on the plants of the northwest Amazon, offers a number of native names of plants of this rich flora.

During several of my trips to the Amazon area, spot field tests were made on plants for alkaloids. Most of these plants have never been chemically studied; in fact, many of the genera and even families of these plants are phytochemically unknown. While spot tests, especially those conducted under field conditions, are initial, exploratory and often crudely carried out, they do offer—especially with the paucity of phytochemical knowledge of such a rich, yet poorly known, flora—leads which may be of help to investigators interested in the chemical constituents of plants and their possible biodynamic significance.

The voucher specimens cited below are preserved in one or more of the following institutions: the Economic Herbarium of Oakes Ames or the Gray Herbarium, both of Harvard University; in the Herbario Nacional de Colombia in Bogotá; or in the New York Botanical Garden.

To several of my colleagues who have made available data, I express my deep appreciation: Professor Robert F. Raffauf, Mr. Melvin Shemluck and Dr. James L. Zarucchi.

The families are arranged in accord with the Engler-Prantl system, and the genera are listed alphabetically under the families.

Polypodiaceae

Polypodium glaucophyllum *Klotzsch* in Linnaea 20: (1847) 393.

Ecuador: Provincia Pastaza, Río Chicó, village of Río Chicó and vicinity. August 1979. *Shemluck et Nees 203.*

According to the collectors, this scandent fern was used formerly when there was no salt; the leaves are very sweet and are employed to flavour monkey meat. The plant is also valued medicinally, used "when sick so blood does not dry up." The Kechwa name is *catchi-panga.*

Palmae

Mauritiella cataractarum *Dugand* in Rev. Acad. Col. Cienc. 8 (1951) 385.

Colombia: Comisaría del Vaupés, Río Apaporis, Soratama. "In clumps, 5-10 together. Stems devoid of spines. Fruit ripens brown, smaller than usual species." June 21, 1951. *Schultes et Cabrera 12792.*

An oil boiled from the ripe fruits is employed to relieve pain from sprains: it is rubbed warm on the affected muscle. The Puinave name is *kee.* The Kuripako Indians call the tree *ka-da-na'-ree-pe.*

It is probable that the oil from the fruits of other species of Mauritiella as well as those of Mauritia are similarly used.

Commelinaceae

Geogenanthus ciliatus *Brückner* in Notizbl. 11 (1931) 224.

Ecuador: Provincia de Pastaza, Río Chicó, village of Río Chicó. August 1979. *Shemluck et Ness 166.*

The Kechwa name of this plant is *supi-panga.* According to the collectors, the leaf is patted on the buttocks of one suffering from flatulence.

Marantaceae

Calathea altissima (*P. et E.*) *Koernicke* in Bull. Soc. Nat. Mosc. 35, pt. 1 (1862) 141.

Colombia: Comisaría del Amazonas, Río Apaporis, Soratama. "Flower cream-coloured." December 14, 1951. *Schultes et Cabrera 14909.*

The Karapana Indians of the Río Kananarí crush the leaves of this abundant plant to make a poultice for drying up festering sores.

Calathea cyclophora *Baker* in Kew Bull. (1895) 18.

Colombia: Comisaría del Vaupés, Río Vaupés, Cachivera de Tatú. *Schultes, Raffauf et Soejarto 24372.* Río Kuduyarí, Yapobodá. June 25, 1958. *García-Barriga, Schultes et Blohm 15868.*

A decoction of the underground parts of this plant is given orally to counteract effects from snake bite.

Calathea Veitchiana *Hooker fil.*, Bot. Mag. 91 (1865) t. 5535.

Peru: Departamento de Loreto, Río Nanay, Chiriara. "Herb 1.2 m. tall in forest. Leaf dark green above with light green markings along midrib and margin; reddish purple benath; pulvinus pale greenish brown. Peduncle reddish; floral bract pale green above, red beneath. Flowers white." February 28, 1969. *Plowman et Tina 2572.*

The name of this plant in Peru is reported to be *pulma*. According to the collectors, it is "mixed with ayahuasca [Banisteriopsis] to see visions."

Ishnosiphon obliquus (*Rudge*) *Koernicke* in Nouv. Mém. Soc. Nat. Mosc. 11 (1859) 341.

Colombia: Comisaría del Amazonas, Río Amazonas, vicinity of Leticia. "Height 12 feet. Nether surface of leaves whitish. Flowers yellow, calyces reddish." August 29 September 12, 1966. *Schultes, Raffauf et Soejarto 24019.*

All parts of this plant are alkaloid-negative with a Dragendorff spot-test.

Piperaceae

Peperomia glabella (*Sw.*) *A. Dietrich* var. **melanostigma** *Dahlstedt* in Kgl. Sv. Vet. Akad. Handl. 33, pt. 2 (1900) 122.

COLOMBIA: Comisaría del Putumayo. *Schultes et Smith 2059.*

This herb is a presumed remedy for conjunctivitis. In the Colombian Putumayo, it is widely employed in the form of a tea and baths to relieve this most common ailment.

The Spanish name of the plant in the region is *flor de mal*; the Ingano name is *tre-gwen, givinan.*

MORACEAE

Helicostylis scabra (*Macbr.*) *C.C. Berg* in Acta Bot. Néerl. 18 (1969) 464.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Raudal de Yayacopi. "Enormous tree. Latex white. Fruit green, edible." February 18, 1952. *Schultes et Cabrera 15466.*

The Makuna call this tree *meé-o* and utilize the latex, which they maintain is toxic, in alleviating cases of extreme intestinal parasitism. The latex is said to be bitter and is mixed with warm chicha. Very small doses must be taken.

The Puinaves, who know the tree as *han-shee-má*, do not utilize the latex as a vermifuge but value it as an anti-fungal agent when repeatedly painted and dried on infected parts of the skin.

Helicostylis tomentosa (*P. et E.*) *Rusby* in Mem. Torr. Bot. Club 6 (1896) 120.

COLOMBIA: Comisaría del Amazonas, Leticia. November 1948. *Schultes et López 10400j.*

The latex of this tree is considered by Indians of the Leticia area to be toxic when ingested.

Pseudolmedia laevigata *Trécule* in Ann. Sc. Nat., ser. 3, 8 (1847) 129, t. 5.

COLOMBIA: Comisaría del Amazonas, Río Apaporis, Soratama. "Fruit red, soft, Small tree." February 4, 1952. *Schultes et Cabrera 15147.*

A tea made from the young twigs of *Pseudolmedia laevigata* is esteemed by the Indians of the middle Apaporis as an excellent stimulant of the appetite.

Proteaceae

Euplassa saxicola (*R.E. Schult.*) *Stevermark* in Fieldiana Bot. 28, no. 1 (1951) 217.

Roupala saxicola R.E. Schultes in Bot. Mus. Leafl., Harvard Univ. 13 (1949) 300, t. 33.

Colombia: Comisaría del Vaupés, Río Macaya, Cerro Chiribiquete. "Small tree. Fruit yellow." May 15-16, 1943. *Schultes 5457.*

Amongst the Karijonas of the upper Río Vaupés, the seeds of this small tree are considered to be toxic when ingested.

Panopsis rubescens (*Pohl*) *Pittier*, Contrib. Fl. Venez. 22 (1923) 21.

Colombia: Comisaría del Amazonas, Río Amazonas, Soratama. "Small tree. Flowers white." August 16, 1951. *Schultes et Cabrera 13543.*

The leaves and stems of this tree are considered to be "medicinal" by Indians of the middle Apaporis region, but the specific uses were not elucidated; use of the plant, however, is stated to be dangerous, since the plant has the reputation of being toxic. Panopsis is reported to be one of the genera of the Proteaceae which accumulates minerals (Hegnauer, R.: *Chemotaxonomie der Pflanzen* 5 (1969) 410).

Olacaceae

Heisteria Spruceana *Engler* in Martius, Fl. Bras. 12, pt. 2 (1872) 15.

Colombia: Comisaría el Vaupés, Río Apaporis, Jinogojé. "Small tree. Fruit yellow, Bracts red." June 20, 1952. *Schultes et Cabrera 16762.*

Amongst the Indians of the Ríos Apaporis and Piraparaná, this small tree is considered to be medicinal. Repeated applications of a warm, strong infusion of the leaves and branches are employed to reduce swelling and pain from sprains of the knees, ankles and wrists.

In the Makuna language, the plant is called *he-tá-soo-tee*; in Puinave, *choo-he-oó-it* and *kön-pep* ("tree of the corocoro bird"); and in Tanimuka, *wy-ee-na-gó*.

Balanophoraceae

Helosis cayennensis (*Sw.*) *Sprengel*, Supl. 3 (1826) 765.

Colombia: Comisaría del Amazonas, Río Loretoyacu. November 1944. *Schultes 6197*. Same locality. October 1945. *Schultes 6829*.—Río Boiauassú. October 29, 1946. *Black et Schultes 46-241*.—Comisaría del Vaupés, Río Apaporis, Raudal de Jerijerimo. March 1951. *Schultes et Cabrera 12091a*.

This saprophyte is known in the Leticia area of Colombia as *cajamba*. In the Vaupés of Colombia, the Indians believe that this plant, dried and pulverized, is an excellent styptic.

In the Brazilian Amazon, the juice of the plant is considered to be astringent and styptic (LeCointe: *A Amazônia Brasileira*, Libraria Classica, Belém, Pará 3 (1934) 157.

Menispermaceae

Curarea tecunarum *Barneby et Krukoff* in Mem. N.Y. Bot. Gard. 2, pt. 22 (1971) 12.

Colombia: Comisaría del Amazonas, Río Loretoyacu, Puerto Nariño, Lago Tarapoto. "Bejuco de unos 6 m. de longitud; tallo aplando con unos 3 cm. de ancho. Hoja de color verde en el haz y blanco en el envez de tamaño regular. Corteza de sabor amargo; nerviación de la hoja en forma saliente." *Diaz 1136*.

This well known ingredient of curare is called *taufe lleida* by the Witoto Indians who, in the vicinity of Lago Tarapoto near the mouth of the Río Loretoyacu, formerly mixed the bark and leaves with other unspecified plants in preparing the poison. In many regions, the species is employed for this purpose with no admixture.

Annonaceae

Guatteria Duckeana *R.E. Fries* in Acta Hort. Berg. 12 (1939) 468.

Colombia: Comisaría del Vaupés, Río Vaupés, Cachivera de Tatú. "Tree 45 feet. Flowers green." October 10, 1966. *Schultes, Raffauf et Soejarto 24377*.

All parts of this tree are strongly alkaloid positive with a Dragendorff spot test.

Guatteria dura *R.E. Fries* in Acta Hort. Berg. 12 (1939) 499.

Colombia: Comisaría del Vaupés, Río Kuduyarí. "Tree 18 feet. Flowers yellow-green cauliflorous." October 10, 1966. *Schultes, Raffauf et Soejarto 24391*.

The bark of this tree is strongly alkaloid-positive with a Dragendorff test; the leaves are slightly positive.

Guatteria modesta *Diels* in Notizbl. 9 (1924) 139.

PERU: Departamento de Loreto, Ushpacano, 2 hours from Iquitos. "Tree 10 m., 10 cm. diameter. January 12, 1968. *Tello et Tina 2037.*

This tree is known in the Peruvian Amazon as *carahuasca*. It is the source of a preparation thought to be contraceptive. The collectors' notes state: "Chop up the bark (only bark is used, not the other parts of the plant) and boil it in water for one minute; then take it out from the fire and leave it until it is tepid. Start to drink 1 cup in the morning and another at the evening (it must be prepared about 6 o'clock). This preparation must be drunk during the menstruation, until it finishes. This prevents not to have baby."

Xylopia amazonica *R. E. Fries* in Acta Horti. Berg. 12 (1939) 562.

COLOMBIA: Comisaría del Amazonas, Río Apaporis, Soratama. "On highlands. Large tree. Flowers white. September 28, 1951. *Schultes et Cabrera 14146.*

Indians along the Río Apaporis take a tea made of the leaves and stems to induce sleep.

Xylopia aromatica (*Lam.*) *Martius*, Fl. Bras. 13, pt. 1 (1841) 43.

COLOMBIA: Comisaría del Amazonas, Leticia. August 17, 1964. *Fernandez-Peréz 6856.* Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. September 27 October 20, 1966. *Schultes, Raffauf et Soejarto 24179.* — Río Vaupés, Urania. October 12, 1966. *Schultes, Raffauf et Soejarto 24393.*

The Witotos of the Río Igaraparaná value a weak tea of the leaves as a strong diuretic taken to reduce edema of the legs; according to the natives, it must be used with extreme caution. The seeds are dried and kept for use as carminatives by Indians suffering from digestive problems.

The collection *Fernandez-Peréz 6856* was strongly alkaloid-positive with Dragendorff spot test. *Schultes, Raffauf et Soejarto 24393*, on the other hand, was only slightly positive.

LAURACEAE

Nectandra globosa (*Aubl.*) *Mez* in Jahrb. Bot. Gard. Berlin 5 (1889) 415.

Colombia: Comisaría del Amazonas, Río Amazonas, Leticia. "Large tree along shore. Height 80-90 feet, corpulent. Bark smooth, light brown. Flowers white, slightly aromatic." August 29 September 12, 1966. *Schultes, Raffauf et Soejarto 24124.*

The bark of this tree is alkaloid-positive with a Dragendorff reagent spot test; the leaves and twigs are alkaloid negative.

Ocotea opifera *Martius* in Spix et Martius, Reise Bras. 3 (1831) 1128.

Colombia: Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. "Tree 30 feet tall. Fruit green. Fruits pulverized to mix with coca powder for certain dances." September 27 October 20, 1966. *Schultes, Raffauf et Soejarto 24421.*

The fruits of this tree are pulverized and mixed with coca powder for certain dances to make the effects of the coca "stronger." The leaves are alkaloid negative in a spot test for alkaloids with Dragendorff reagent.

Ocotea simulans *C.K. Allen* in Mem. N.Y. Bot. Gard. 10 (1964) 99.

Colombia: Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. September 27 October 20, 1966. "Small tree. Flowers yellowsh. Leaves and twigs slightly alkaloid-positive." *Schultes, Raffauf et Soejarto 14174.* Same locality and date. *Schultes, Raffauf et Soejarto 24200.*

The leaves of *Ocotea simulans* are roasted and pounded with coca leaves for certain ceremonies. The reason for using the leaves of this lauraceous plant is said to be that the admixture acquires a more pleasant taste.

The leaves and twigs reacted positively to a spot test for alkaloids with Dragendorff reagent.

Capparidaceae

Crataeva Benthmii *Eichler* in Martius, Fl. Bras. 13, pt. 1 (1865) 265.

Colombia: Comisaría del Amazonas, Río Amazonas near mouth of Río Loretoyacu. "Small tree. Flowers basally green; long filaments purple." September 13 15, 1966. *Schultes, Raffauf et Soejarto 24133.*

Peru: Departamento de Loreto, Iquitos region, Moyuy. "Small tree, 5 m. Flowers pale green." July 26, 2966. *Martin et Lau-Cam 1133.*

This tree, locally called *tamara*, is poisonous if taken internally, according to the collectors. In Brazil, however, leaves and roots are said to be employed as a tonic and stomachic, and the juice of the leaves is used externally to relieve rheumatism (LeCointe A.: Amazônia Brasileira 3 (1934) 112). The fruit or bark are mixed with water and used to wash the skin for "lobosisso," a plague which makes the skin black.

The leaves and twigs are alkaloid positive with a Dragendorff spot test; the bark is negative.

Crataeva Tapia *Linnaeus*, Sp. Pl. (1753) 444.

Colombia: Comisaría del Amazonas, Río Amazonas, near mouth of Río Loretoyacu. September 13–15, 1966. *Schultes, Raffauf et Soejarto 24156.*

The leaves of *Crataeva Tapia* are said by the Witoto Indians to be in tea form an effective stomachic.

Crassulaceae

Bryophyllum pinnatum *Aschers et Schweinfurth*, Ill. Fl. Egypte ex Mem. Inst. Egypt. 2 (1887) 79.

Peru: Departamento de Loreto, Iquitos, Uchpacano. "Cultivated herb." July 28, 1966. *Martin et Lau-Cam 1116.*

According to the collectors, this herb, known in Peru as *paichecara*, is medicinally used: the leaves are mixed with a small amount of aquardiente and applied to the temples for headache and a decoction of the leaves is drunk for "intestinal irritations."

Chrysobalanaceae

Hirtella bullata *Bentham* in Hooker, Journ. Bot. 2 (1840) 216.

Colombia: Comisaría del Vaupés, Río Karurú. "Flowers white," April 12-15, 1953. *Schultes et Cabrera 19161.*

The bark is prepared in a tea to treat sore throats due to prolonged "gripa."

In the Amazon of Brazil the bark of *Hirtella bracteata* Mart. et Zucc. is considered to be astringent (LeCointe: loc. cit., 130).

Hirtella guainiae *Spruce ex Hooker fil.* in Martius, Fl. Bras. 14, pt. 2 (1867) 31.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Javareté. "Low bush. Flowers pale pink." May 14-24, 1953. *Schultes et Cabrera 19421.*

A tea of the bark is recommended as a gargle for sore throat.

Hirtella racemosa *Lamarck* var. **hexandra** (*Willd. ex R. et S.*) *Prance* in Fl. Neotrop., no. 9 (1972) 328.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, between Mitú and Javareté, Arara Cachivera. "Low bush. Fruit dark red." May 14-24, 1953. *Schultes et Cabrera 19398.*

The bark and leaves of this bush are prepared in a tea which is taken as hot as possible "to open the throat" in cases of extreme respiratory ailments.

Licania apetala (*E. Mey.*) *Fritsch* in Ann. K.K. Naturh. Hofmus. Wien 4 (1889) 54.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, Cerro Isibukuri. Tree. Diameter 15 in.; height 75 feet. August 3, 1951. *Schultes et Cabrera 13276.*

In Spanish, this tree is called *cabio.* The Puinave name is *wan-choó*; Kabuyarí, *ká-ve*; Kuripako, *ká-ve*; Taiwano, *khá-mwa.*

The bark is burned and the ashes are mixed with clay to make strong ceramic pots.

Licania heteromorpha *Bentham* var. **glabra** (*Mart. ex Hook. fil.*) *Prance* in Fl. Neotrop., no. 9 (1972) 108.

COLOMBIA: Comisaría del Vaupés, Río Kananarí. August 6, 1951. *Schultes et Cabrera 13416.*—Río Vaupés, Mitú and vicinity. "Fruit brown; large tree." September 27 October 20, 1966. *Schultes, Raffauf et Soejarto 24198.*

The leaves and fruits are slightly alkaloid-positive with a Dragendorff spot test.

LEGUMINOSAE

Anadenanthera peregrina (*L.*) *Spegazzini* in Physis 9 (1923) 313.

In the Río Negro area of Brazil, this tree, the seeds of which are the source of an hallucinogenic snuff called paricá or yopo, is

to-day extremely rare. The tree grows most appropriately in open grasslands or savannahs, never in heavy forests. The species is now very common in the upper Orinoco area and in the savannahs of the Río Branco. It is rarely seen nowadays in the Río Negro, where apparently it was once frequently cultivated.

Over a century ago, Spruce reported: "I first gathered specimens of the Paricá (or Niopo) tree in 1850 in Santarem at the junction of the Tapajoz and Amazon where it had apparently been planted. In the following year, I gathered it on the little river Jauauarí—one of the lower tributaries of the Río Negro—where it was certainly wild."(A.R. Wallace [Ed.]: *Notes of a Botanist on the Amazon and Andes* 2 (1908) 426).

In my several years in the Río Negro basin, I never encountered *Anadenanthera peregrina*, but Dr. Ghillean T. Prance located trees near the mouth of the Rio Une, a small affluent of the Río Negro. Dr. Prance writes: "These trees are in a field beside the river where they grow in a group. They are regularly visited each year by a group of Yanomamo who harvest them."

It is interesting that certain plants, common enough apparently along the Río Negro a century ago, are now nearly non-existent in the area. Another example is the guaraná plant, *Paullinia Cupana*, which, in Spruce's time, was apparently frequent all along the Río Negro obviously planted. To-day, it is hardly ever seen along this river and, if so, is planted only as a curiosity.

Mimosa pudica *Linnaeus*, Sp. Pl. (1753) 518.

ECUADOR: Provincia Pataza, Río Chicó, affluent of Río Pastaza, Village of Río Chicó. "White flower." August 1979. *Shemluck et Ness 211.*

The Kechwa name for this plant in Ecuador is *punyo-sisa*. According to the collectors, the leaves are put in pillows for the elderly and children who cannot sleep.

Parkia oppositifolia *Spruce ex Bentham* in Trans. Linn. Soc. 30 (1875) 363.

BRAZIL: Estado do Amazonas, basin of Río Negro, Río Ineiuxí, Makú Indian village 300 km. above mouth. "Tree, 10 m. x 30 cm. diameter." October 24, 1971. *Prance, Maas et al. 15594.*

According to the collectors, the bark of the trunk is scraped and added to water to prepare a drink for curing dysentery. The Makú name of the tree is *piradábi*; in Portuguese, it is called *arapari*.

Spartium junceum *Linnaeus*, Sp. Pl. (1753) 708.

ECUADOR: Provincia Azuay, along Río Tarqui, near 8,300-9,000 feet alt. "Erect shrubs to 3 m. Stems bright green. Floral parts bright yellow. An exceeding common escape on almost all dry slopes in the Cuenca area." March 7, 1945. *Camp E-205*. Provincia Cañar, near village of San Marcos, northeast of Azogues. "Shrubs to 1.5 m. Flowers yellow. The flowers are used to adorn the Mother of God." April 1, 1945. *Camp E-2501*.

This introduced shrub, known in highland Ecuador as *retama*, is believed to have abortifacient properties. According to Camp, "an infusion of the roots is taken by women who do not want children." The dried flowers are also "smoked as a cigarette for asthma."

GERANIACEAE

Geranium rhomboidale *Moore* in Gentes Herb. 8, fasc. 3 (1951) 255, t. 103.

COLOMBIA: Comisaría del Putumayo, Páramo de San Antonio between La Laguna de La Cocha and the Valley of Sibundoy. Alt. 3000–3200 m. February 13, 1942. *Schultes* 3238.—Road from Sibundoy to Pasto, between La María and Páramo de San Antonio. Alt. 2900–3180 m. June 1, 1946. *Schultes et Villarreal 7825*.

In the Sibundoy Valley, the crushed leaves of *Geranium rhomboidale* are considered to have styptic properties.

DICHAPETALACEAE

Stephanopodium peruvianum *Poeppig et Endlicher*, Nov. Gen. et Sp. 3 (1843) 40.

COLOMBIA: Comisaría del Amazonas, Río Apaporis, Soratama. "Small tree. Fruit green." September 28, 1951. *Schultes et Cabrera 14157*.—Comisaría del Putumayo. *Plowman 2042*.

In the Colombian Putumayo, this plant is known as *calentura-caspi* ("fever-tree") or *chiric-caspi* (the same meaning). It is employed as a febrifuge.

Nothing is known of the chemical constituents of this genus, but some African species of Dichapetalum are reputedly toxic (Hegnauer: loc. cit. 4 (1966) 15).

Euphorbiaceae

Hevea guianensis *Aublet*, Hist. Pl. Guian. Fr. 2 (1775) 871.

Peru: Departamento de Loreto, Provincia Maynas, Río Ampiyacu, Pucu Urquillo and vicinity. "Tree 60 feet tall, 10 inches in diameter. Bark smooth, tan-grey. Latex cream." April 28, 1977. *Plowman, Schultes et Tovar 7125* (Alpha Helix Amazon Expedition 1976-77. Phase VII).

A field chemical examination revealed that this species of Hevea is devoid of alkaloids.

Hieronyma colombiana *Cuatrecasas* in Rev. Acad. Col. Cienc. 8 (1951) 298.

Colombia: Comisaría del Putumayo, Páramo de San Antonio, 3000–3200 m. "Small tree. Fruit edible, for making wine also." February 13, 1942. *Schultes 3253.*

The Kamsá Indians of Sibundoy, who call this plant *ssna-hú-sha*, make an infusion of the bark and leaves to cure "chandra," a skin eruption.

Celastraceae

Maytenus laevis *Reissek* in Martius, Fl. Bras. 11, pt. 1 (1861) 19.

Colombia: Comisaría del Vaupés, Río Kubiyú, Savannah Kañendá. "Small tree. Flowers white." September 27–October 20, 1966. *Schultes, Raffauf et Soejarto 24266.*

This species is the famous *chuchuhuasca* of the Peruvian Amazon. The bark is believed to be a strong stimulant when taken in infusion.

Cyrillaceae

Cyrilla racemiflora *Linnaeus*, Mant. 1 (1767) 50.

Colombia: Comisaría del Vaupés, Río Kuduyarí, Cerro Yapobodá. October 28, 1951. *Schultes et Cabrera* 14472. — Río Kananarí, Cerro Isibukuri. "Tree 10 feet tall." January 23–25, 1952. *Schultes et Cabrera 15034.* — Río Kubiyú, Savannah

Kañendá. "Tree 20 ft. tall. Flowers whitish." September 27-October 20, 1966. *Schultes, Raffauf et Soejarto 24263.*
BRAZIL: Estado do Amazonas, Rio Negro basin. Middle course of Rio Curicuriarí. January 1948. *Schultes et López 9718.*

This plant is alkaloid negative with a Dragendorff spot test.

The Indians of the Río Curicuriarí in Brazil crush the leaves of *Cyrilla racemiflora* and vigorously rubbed the mass on sprains and muscular pains for relief.

ICACINACEAE

Poraqueiba sericea *Tulasne,* in Ann. Sci. Nat., ser. 3, 11 (1849) 172.

COLOMBIA: Comisaría del Vaupés, Río Piraparaná, Caño Teemeeña. "Small tree. Cultivated. Flowers yellow." September 9, 1952. *Schultes et Cabrera 17319.*—Río Vaupés, between Mitú and Javareté, Tipiaca. May 14-24, 1953. *Schultes et Cabrera 19278.*—Comisaría del Amazonas, Río Karaparaná, El Encanto. "Flowers white-yellow. Small cultivated tree. Fruit ripens yellow. Pulp thin, yellow." March 20 April 2, 1970. *Schultes 26084.* —Comisaría del Amazonas, Río Amazonas, Leticia. "Cultivated tree. 25 feet tall. Flowers yellow."August 29 September 12, 1966. *Schultes, Raffauf et Soejarto* 24012.—Same locality and date. *Schultes, Raffauf et Soejarto 24027.* —Same locality and date. "Tree 40 feet. Flowers whitish yellow." *Schultes, Raffauf et Soejarto 24082.*
PERU: Departmento de Loreto, Río Nanay, Mishana. February 19, 1969. *Plowman 2491.*

All Dragendorff spot tests on this plant proved to be alkaloid-negative.

The tree and its fruit are widely known in Colombia and Peru by the Brazilian name *umarí*. In the Colombian Amazon, it is called *wá-mo* by the Barasanas; *how* by the Puinaves; *mwá-mo* by the Gwananos; *ma-mo-hoỵ-ye* by the Kubeos; and *né-ka-soo* (fruit) and *ne-ka-na* (tree) by the Witotos.

In Peru, the plant is an ingredient in a contraceptive medicine, according to *Plowman 2491.*

SAPINDACEAE

Cupania scrobiculata *Richard* in Acta Soc. Hist. Nat. Paris 1 (1792) 109.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. "Shrub. Fruit red." September 27–October 20, 1966. *Schultes, Raffauf et Soejarto 24298.*

This plant is alkaloid negative with a Dragendorff spot test.

TILIACEAE

Lueheopsis Schultesii *Cuatrecasas* in Bot. Mus. Leafl., Harvard Univ. 15 (1951) 49, t. 17.

COLOMBIA: Comisaría del Amazonas, Río Igaraparaná, La Chorrera and vicinity. June 4-10, 1942. *Schultes 3925.*—Same locality and date. *Schultes 2972.*

The Witotos call this beautiful bush *mo-sé-go-na*. The bark is boiled, and the resulting astringent tea is valued by the Witotos as a remedy for sore throat. The seeds are said to be roasted and eaten.

Triumfetta althaeoides *Lamarck*, Encycl. 3 (1791) 420.

PERU: Departamento de Loreto, region of Iquitos. "Small shrub, 1 m.; flowers pale orange; stamens orange; fruit green turning brown." July 26, 1966. *Martin et Lau-Cam 1160.*

According to the collectors, this shrub is known as *caballusa* and is "used for uterine complaints."

MALVACEAE

Malachra rudis *Bentham*, Pl. Hartweg. (1845) 164.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, on summit of Cerro Mitú. "Low shrub, 3 feet." September 27–October 20, 1966. *Schultes, Raffauf et Soejarto 24342.*

A spot test for alkaloids with Dragendorff reagent was negative for this plant.

Sida cordifolia *Linnaeus*, Sp. Pl. (1753) 684.

COLOMBIA: Comisaría del Amazonas, Río Amazonas, Leticia. "Bush in secondary growth. Flowers pink." August 29 September 12, 1966. *Schultes, Raffauf et Soejarto 24085.*

This plant gave an alkaloid-negative reaction to a Dragendorff spot test.

BOMBACACEAE

Bombax coriaceum *Martius*, Nov. Gen. et Sp. 1 (1826) 93.

COLOMBIA: Comisaría del Vaupés, Río Karurú, Mesa de Yambí, Savannah Goo-ran-hoo-dá. "Flowers white. Bush 2 1/2 feet tall." April 15-16, 1953.

Schultes et Cabrera 19158.—Río Kubiyú, Savannah Kañendá. "Bush 3 feet." September 27–October 20, 1966. *Schultes, Raffauf et Soejarto 24280.*

Bombax coriaceum gave an alkaloid-negative reaction to a spot test with Dragendorff reagent.

Bombax globosum *Aublet*, Hist. Pl. Guian. Fr. 2 (1775) 701, t. 281.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, Cerro Isibukurí. "Large tree, 60-70 feet tall. Flowers yellow-white, petals yellow towards tip." September 29, 1951. *Schultes et Cabrera 14700.*

The "wool" from the fruit is mixed with resins or latexes and painted on wounds or ulcers as a kind of protective "skin." The Taiwanos call the tree *ka-ne-weé-re.*

Bombax Munguba *Martius*, Nov. Gen. et Sp. 1 (1826) 93, t. 99.

PERU: Departamento de Loreto, region of Iquitos, Moyuy. "Tree 25 m. tall; fruit red." July 26, 1966. *Martin et Lau-Cam 1135.*

According to the collectors, a decoction of this plant, locally known as *punga, punga blanca* or *huina caspi*, is taken for snake bite.

Matisia cordata *Humboldt et Bonpland*, Pl. Aequin. 1 (1805) 9, t. 2.

COLOMBIA: Comisaría del Amazonas, Río Amazonas near mouth of Río Loretoyacu. "Tree 60 feet tall. Flowers yellow." September 13–15, 1966. *Schultes, Raffauf et Soejarto 24111.*—Same locality and date. *Schultes, Raffauf et Soejarto 24117.*

The results of a spot test for alkaloids with Dragendorff reagent gave the following results: bark doubtful; leaves positive.

Septotheca Tessmannii *Ulbrich* Notizbl. 9 (1924) 129, fig. 3.

COLOMBIA: Comisaría del Amazonas, Río Boiauassú, Trapecio Amazónico. "Enormous tree with buttress roots. Flowers yellow-green, mucilaginous." November 1945. *Schultes 6788.*—Same locality. "Sepals green-yellow. Tree 80 feet tall with great buttresses. Very common." October 27, 1946. *Schultes 8612.*

This tree is called *zapoterana* or *zapotilla* in the Trapecio Amazónico. It is a rare element of the flora of this area.

Sterculiaceae

Sterculia roseiflora *Ducke* in Arch. Inst. Bio. Veg. Río Janeiro 2 (1935) 57.

Colombia: Comisaría del Vaupés, Río Apaporis, Soratama. "Large tree. Flowers fragrant, reddish purple. On high land." September 28; 1951. *Schultes et Cabrera 14143.*

This tree is locally known as *turí*. The stems are boiled in water to make an unusually strong diuretic tea.

Caryocaraceae

Caryocar glabrum (*Aubl.*) *Persoon*, Syn. 2 (1806) 84.

Colombia: Comisaría del Vaupés, Río Apaporis, Soratama, "Enormous tree. Flowers yellow; stamens bright red." September 26, 1951. *Schultes et Cabrera 14139.*

The Puinave name for this treelet is *haw*. The seeds are used, uncooked, as a food. They are also considered to be medicinally useful in what appears to be an attempt to regulate menstruation.

Guttiferae

Lorostemon colombianum *Maguire ex R.E. Schultes* in Bot. Mus. Leafl., Harvard Univ. 18 (1958) 159.

Colombia: Comisaría del Vaupés, Río Apaporis, Jinogojé (at mouth of Río Piraparaná) and vicinity. "Tree 6 m. high. Flowers outside red, greenish at base and red-spotted above; calyx green. Latex yellow." September 25, 1952. *Schultes et Cabrera 17619.*—Río Ricapuyá (tributary of Río Apaporis below mouth of Río Piraparaná). "Small tree 6 m. tall. Latex yellow. Flowers red. September 25-26, 1952. *Schultes et Cabrera 17638.*

The Puinave call this small tree *boo-kwaṅ*, the Makuna know it as *chee-kãṅ-hoo*; and the Makú of the Río Piraparaná refer to it as *tee-ran-keṅ*.

Lorostemon stipitatum *Maguire* in Mem. N.Y. Bot. Gard. 10 (1963) 130.

Colombia: Comisaría del Vaupés, Río Piraparaná, lower course. "Medium-sized tree. Sparse white latex." March 9, 1952. *Schultes et Cabrera 15910.*

The Makuna Indians of the Río Piraparaná know this tree as *o-hé-wo-bök*.

Moronobea coccinea *Aublet*, Hist. Pl. Guian. Fr. (1775) 788, t. 33 excl. figs a-f.

COLOMBIA: Comisaría del Amazonas, Río Caquetá, La Pedrera and vicinity, Quebrada Tonina. "On high land. Large tree. October 5, 1952. *Schultes et Cabrera 17728*.—Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. "Columnar tree 1 1 2 feet in diameter. Height 90 feet. Crown sparse, all at top. Bark thick, soft, roughish, brown outside, sandy inside. Latex abundant, yellow. Wood yellowish white. Flowers rose-red." September 8, 1951. *Schultes et Cabrera 13960*.

In the Vaupés, the Tukano name of this tree is *woo-há-pee-ka-ne*, and the Taiwono call it *go-hé*. The Kabuyarí in La Pedrera know it as *maú-pa*.

Moronobea riparia (*Spr.*) *Planchon et Triana* var. **fimbrillata** *R.E. Schultes* in Bot. Mus. Leafl., Harvard Univ. 17 (1955) 15.

COLOMBIA: Comisaría del Vaupés, Río Guainía, Puerto Colombia. "Flowers greenish white. Stigmas and pistil bright green. Latex bright yellow. Bark thick, scaley, dark-brown, corky. Tree storeyed. Height 40 feet. Diameter 14 inches." October 31-November 2, 1952. *Schultes, Baker et Cabrera 18206*.—Same locality and date. *Schultes, Baker et Cabrera 18210*.

The Puinave name of this beautiful variety is *möw*; the Kuripako call it *ma-rá-ke*. In Spanish, the tree is known by the general term *breo* and in Lingua Geral as *i-raí-kee*.

Platonia insignis *Martius* var. **formosa** *R.E. Schultes* in Bot. Mus. Leafl., Harvard Univ. 17 (1955) 18.

COLOMBIA: Comisaría del Vaupés, Río Piraparaná, Raudal de La Olla. "Tree 25 m. Columnar. Bark grey-brown, rough with scales. Flowers salmon-pink, petals curl out at edge. Receptable thick, same colour. Latex cream-coloured. On rocks at falls. Crown not large." August 28, 1952. *Schultes et Cabrera 17062*.—Río Vaupés, mouth of Río Kerarí. "Flowers salmon-pink. Columnar tree, diameter 28 inches. Latex resinous, yellow. Anthers yellow. Bark shaggy, rich brown. Wood whitish. Latex used to light houses. Just above high water line." May 14-15, 1953. *Schultes et Cabrera 19342*.

The Tanimuka name of this tree is *oo-ká-o-ree-ke*; the Yukuna call it *ke-pé-la* (*Schultes et Cabrera 17062*). Amongst the Desana of the Río Vaupés, it is known as *ko-me-peé-go-re*, while the neighbouring Tukano call it *ko-paí-yo-ree*.

The seeds of *Platonia insignis* have an oil content of 0.5% (Hegnauer: loc. cit., 4 (1966) 221).

Symphonia globulifera *Linnaeus fil.*, Suppl. (1781) 302.

COLOMBIA: Comisaría del Vaupés, Río Piraparaná, Caño Oo-moó-ña. September 3, 1952. *Schultes et Cabrera 17163.*

The Makuna Indians of the Río Piraparaná burn the bark and apply the ashes to wounds. A similar use in the Río Apaporis has been reported for this species (Schultes: Bot. Mus. Leafl., Harvard Univ. 26 (1978) 234).

POTALIACEAE

Potalia Amara *Aublet*, Hist. Pl. Guian. Fr. (1773) 394, t. 151.

PERU: Departamento de Loreto, Provincia Maynes, Río Yaguasyacu, affluent of Río Ampiyacu, Brillo Nuevo and vicinity. "Shrub 2 m. tall in forest. name: *okaji kahpuu* (Bora)." April 12, 1977. *Plowman, Schultes et Tovar* 6803 (Alpha Helix Amazon Expedition 1967-1977, Phase VII).

The Boras, who know this plant as *okaji-kahpuu*, chop fresh leaves in water and take it internally for snakebite or against any poisonous animal (raya, isula). It is said to calm the body and eliminate pain.

Notwithstanding the extensive medicinal use of *Potalia Amara* throughout the Amazon, the chemistry of this genus is, according to Gibbs, "too poorly known to justify discussion" (Gibbs: *Chemotaxonomy of Flowering Plants*, McGill-Queen's, University Press, Montreal 3 (1974) 1333-1334).

APOCYNACEAE

Rhigospira quadrangularis (*Muell.-Arg.*) *Miers*, Apocyn. S. Am. (1878) 68.

COLOMBIA: Comisaría del Vaupés, Río Macaya. "Slender tree, 50 feet tall. Very abundant thick, white latex similar to but not that of juansoco. Bark thin, smooth with black-grey patches." April 1-7, 1943. *Schultes 5357.*

According to Zarucchi, this collection, reported as *Neocouma Duckei* (Schultes in Acta Bot. Neerl. 15 (1966) 182), is now correctly identified as *Rhigospira quadrangularis*. It is used, under the local name *caimo morado*, to adulterate the latex of *Couma macrocarpa* Barb.-Rodr. in the upper Río Apaporis basin of Colombia. The tree is called *palo de leche* or *caimo morado* in the region.

Tabernaemontana Sananho *Ruiz & Pavón*, Fl. Peruv. 2 (1799) 22, t. 144.

PERU: Departamento de Loreto, Maucallacta, Río Paranapura. "Tree 3–4 meters. Flowers greyish white. *Yacu Zanango*." January 1935. *G. Klug 3942*.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu, near Puerto Nariño, around Laguna Dolfus. "N.v.-*sanango*. Hierba de 1 m. hasta arbustiva de 3 m. Flores blancos." August 19, 1964. *Fernández-Pérez 6867*.

This species proves to be highly positive with a spot test for alkaloids with Dragendorff reagent.

ASCLEPIADACEAE

Metelea palustris *Aublet*, Hist. Pl. Guian. Fr. (1775) 278, t. 109, f.1.

ECUADOR: Provincia Pastaza, Río Chicó, Village of Río Chicó and vicinity. August 1979. *Shemluck et Ness 190*.

The leaves are cooked and eaten and are said to turn the teeth red. There is apparently no utilitarian purpose involved in eating the leaves.

The chemistry of this genus is apparently unknown.

RUBIACEAE

Duroia *Linnaeus fil.*

This tropical American genus of some 20 species belongs to that portion of the Rubiaceae – the Gardeniinae – which is not particularly noted for alkaloids with the exception of three genera: Randia, Basanacantha and Hamelia. The section has, however, not been thoroughly investigated. In an earlier paper, I indicated the native uses of a number of species of Duroia and noted that "...reports from natives affirming the poisonous properties of the seeds of several species...call attention once again to the need for phytochemical studies guided by ethnobotanical observations." (Schultes in Bot. Mus. Leafl., Harvard Univ. 22 (1969) 151–156).

Duroia hirsuta (*P. et E.*) *K. Schumann* in Martius, Fl. Bras. 6, pt. 6 (1889) 367.

COLOMBIA: Comisaría del Putumayo, Río Sucumbios, Conejo and vicinity. April 2–5, 1940. *Schultes*

The Kofán Indian name of *Duroia hirsuta* in the Putumayo is *sha-ka-ker-ná-se.*

Duroia kotchubaeoides *Steyermark* in Mem. N.Y. Bot. Gard. 12 (1965) 201.

COLOMBIA: Comisaría del Vaupés, Río Guainía, Puerto Colombia and vicinity. "Small tree. Flowers white." October 31–November 2, 1952. *Schultes, Baker et Cabrera 28111.*

A Dragendorff spot test for this species is alkaloid negative. The seeds are said by the natives to be poisonous when eaten.

Duroia petiolaris (*Spr.*) *Hooker fil. ex K. Schumann* in Martius, Fl. Bras. 6, pt. 6 (1889) 364.

COLOMBIA: Comisaría del Amazonas, Trapecio Amazónico, Río Loretoyacu. October 1945. *Schultes 6727.*

The Tikuna Indians assert that the seeds of this species are dangerously toxic if ingested.

Durioa saccifera (*Mart.*) *Hooker fil. ex K. Schumann,* in Martius, Fl. Bras. 6, pt. 6 (1889) 362, t. 146, fig. 1.

COLOMBIA: Comisaría del Amazonas, Río Apaporis, Soratama and vicinity. March 26, 1952. *Schultes et Cabrera 16063.*

A spot test with Dragendorff reagent indicates that this collection is doubtfully alkaloidal. The seeds are said by the natives to be toxic if ingested.

SOLANACEAE

Solanum hypomalacophyllum *Bitter ex Pittier,* Man. Pl. Usual. Venez. (1926) 137.

The common name of this plant in Venezuela—*borrachera*—indicates that it is an intoxicant (Herbarium collection: *Gehringer 2*).

It is possible that this species of Solanum contains tropane alkaloids so widespread in the family, but an analysis has apparently not been made.

Centropogon ferrugineus (*L. fil.*) *Gleason* in Bull. Torr. Bot. Club 52 (1925) 11.

COLOMBIA: Comisaría del Putumayo, Páramo de San Antonio, March 1953. *Schultes s.n.*

In Sibundoy, a bitter tea of the leaves of this plant is valued in treating dysentery.

Chemical studies apparently have not yet been carried out on *Centropogon*.

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NEW SPECIES OF *ERYTHROXYLUM* FROM BRAZIL AND VENEZUELA

TIMOTHY PLOWMAN[1]

Erythroxylum Leal-costae Plowman, *E. occultum* Plowman and *E. hypoleucum* Plowman are described and illustrated, and their ecology and taxonomic relationships discussed. *Erythroxylum Leal-costae* and *E. occultum* are known only from urban areas in Brazil and are pointed out as endangered species.

As a result of taxonomic studies of the genus *Erythroxylum* in preparation of a treatment for *Flora Neotropica*, numerous undescribed species have been discovered, particularly from Brazil and Venezuela. A number of these are known only from urban areas and other environments rapidly undergoing habitat destruction. It is the purpose of this paper to call attention to two of these species from Brazil—*E. Leal-costae* from Salvador, Bahia, and *E. occultum* from Rio de Janeiro—in order to underscore their endangered status.

Erythroxylum (sect. *Rhabdophyllum*) **Leal-costae** Plowman, *sp. nov.*

Frutex dense ramosus. Ramuli crassi et rigidi. Stipulae coriaceae, persistentes, striatae, 3–setulosae. Folia ad apices brachyblastorum producta, brevissime petiolata; laminae ellipticae vel late obovatae, apice rotundatae, retusae vel emarginatae, coriaceae. Flores fasciculati in axillis foliorum a brachyblastis hornotinis producti, pedicello brevi et incrassato. Petali lamina concava, late ovata. Urceolus stamineus quam calyx paulo longior, ad marginem 10–denticulatus. Drupa anguste ovoidea, endocarpio subtereti, dorsaliter 3–sulculato, apice acuto, ad maturitatem uniloculari, endospermio abundanti.

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SHRUB or TREELET to 3 m. tall with dense, spreading crown and single trunk to 6 cm. in diameter. BARK on trunk rugose, fissured transversely and longitudinally into rectangular segments, whitish grey to dark brown, 7–10 mm. thick; inner bark reddish brown; wood pale reddish tan. BRANCHES spreading, diffuse, terete, dark to light grey. BRANCHLETS distichous, divaricating at wide acute to right angles, straight or somewhat curved toward apex, thick, rigid, strongly flattened toward apex, 3–4 mm. wide, 2 mm. thick, initially light green, turning dark grey and drying blackish, smooth or somewhat longitudinally wrinkled, the lenticels sparse, punctate to briefly elongate, whitish. INTERNODES 5–20 mm. long on long shoots, highly contracted and ca. 1 mm. long on short shoots. RAMENTA congested at base of longer shoots 5–25 mm. along stem or covering short shoots, black. STIPULES persistent, appressed, diverging to ca. 45° with age, broadly triangular-ovate, 2.0–3.5 mm. long, coriaceous, light green, turning black with age, distinctly striate when young with 3–5 nerves per side, apically obtuse to truncate, 3–setulose, the setae 0.6–1.0 mm. long, very fragile and early disappearing, the keels prominulous, subulate, the margin entire. LEAVES deciduous, 2–3 produced at tips of branchlets, distichous, very short petiolate, the lamina stiff, held erect, plane or nearly so, elliptic to obovate, sometimes orbicular, apically rounded, retuse or emarginate, basally obtuse or rounded, 30–60 mm. long, 20–45 mm. wide, coriaceous, medium to dark green adaxially, light yellowish green abaxially, drying ferrugineous, shiny to rather dull adaxially, dull abaxially, elineate and without a distinct central panel, the midrib slightly raised, acute in cross section, yellowish adaxially, drying ferrugineous abaxially, the lateral nerves 7–11, straight, diverging 40°–75° from midrib, prominulous to obscure adaxially, abaxially distinct, darker green than lamina, the veinlets abaxially distinct, finely reticulate. PETIOLE short, thick, 1.0–2.5 mm. long, 1.5–2.0 mm. in diameter, subterete, dark brown, drying black. FLOWERS in axillary fascicles on current season's shoots, often congested near apex of short shoots, with 1–6 flowers per node; flower color unknown. BRACTEOLES 3 per flower, sub-

orbicular to triangular, 0.8–1.0 mm. long, membranaceous, apically obtuse to rounded, with one submedial nerve, 1-setulose, the seta 0.1–0.3 mm. long. PEDICEL short, thick, pentangular, 1.5–2.0 mm. long, 1.0–1.5 mm. in diameter. CALYX 1.5–2.0 mm. long, the lobes triangular to broadly ovate, 1.0–1.2 mm. long, apically acute to acuminate, the apex itself obtuse. PETAL limb suberect, concave, broadly ovate in outline, 2 mm. long, 1.5–1.7 mm. wide, rounded at apex, the claw 1 mm. long, the ligule 1.0–1.1 mm. long, bilobate, the lobes with one larger posterior and one smaller anterior lobule, erose at margin, 0.7 mm. long. STAMINAL CUP 1.0–1.5 times as long as calyx, 1.2–1.5 mm. long, 10-denticulate at margin; anthers broadly ovate, apically rounded. BRACHYSTYLOUS FLOWERS: filaments 2.1–2.2 mm. long, the anthers 1.6 mm. long; styles free, 0.8–1.0 mm. long, the stigma broadly depressed-capitate, 1 mm. in diameter, 0.6 mm. thick. DOLICHOSTYLOUS FLOWERS: antesepalous filaments 0.7–1.0 mm. long, the anthers 0.5 mm. long; antepetalous filaments 0.8–1.5 mm. long, the anthers 0.5 mm. long; styles free, 1.3 mm. long; stigma not seen. OVARY not seen. DRUPE narrowly ovoid, apically obtuse, 9–10 mm. long, 4 mm. in diameter, yellowish orange at maturity (*fide Carvalho et al.*), the mesocarp ca. 0.3 mm. thick, the endocarp narrowly ovoid, apically acute, subterete, dorsally shallowly 3-sulculate, unilocular at maturity; endosperm occupying ca. 2/3 of endocarp. EMBRYO 6.5–7.0 mm. long; cotyledons oblong-obovate, plane, 4.2–5.5 mm. long, 3.0–3.2 mm. wide, 1 mm. thick, apically rounded; radicle 1.7–1.8 mm. long.

TYPE: BRAZIL: STATE OF BAHIA: Salvador, entre o Aeroporto e o Stella Maris, Dunas de Itapuã, 23 Mar 1975(fl, fr), *A. Leal Costa s.n.*! (HOLOTYPE, ALCB; ISOTYPE, F 1871789).

ADDITIONAL SPECIMENS EXAMINED: BRAZIL: BAHIA: Município de Salvador. Along road (Av. Otávio Mangabeira = BA-033) from Itapuã to Aeroporto 2 de Julio at first large traffic circle (intersection with Av. Luiz Viana Filho), approx. 12°55′S., 38°21′W., near sea level, 23 May 1981 (young fr), *A. M. de Carvalho et al. 705* (CEPEC, F), 27 Jan 1983 (st), *T. Plowman 12770* (CEPEC, F, 14 duplicates to be distributed); 27 Jan 1983

(st), *T. Plowman 12780* (CEPEC, F, four duplicates to be distributed).

ETYMOLOGY: *Erythroxylum Leal-costae* is named in honor of Dr. Alexandre Leal Costa, dedicated collector of the flora of Bahia who first collected the species in 1975.

DISTRIBUTION: Known only from the type locality in an extremely limited area.

ECOLOGY: *Erythroxylum Leal-costae* is confined to a small area within a region of dune scrubland near the town of Itapuã next to the airport of the city of Salvador, Bahia. This vegetation is included in the broad concept of "restinga" but has been described by Eiten (1968) as "evergreen broadleaf open clumped scrub." The restinga of Itapuã consists mainly of evergreen shrubs and small trees with dense, tortuous branches and coriaceous, evergreen leaves, including *Guettarda platypoda* DC., *Kielmeyera argentea* Choisy, *Croton Sellowii* Baill., *Emmotum affine* Miers, *Ternstroemia* sp., and several Myrtaceae. A recent study of plant dispersal and succession at this site (Morawetz, in press) listed 94 species in some 84 genera and 51 families, but this *Erythroxylum* apparently was overlooked. A number of other species are thought to be endemic at the restinga of Itapuã, including *Aechmea itapoana* W. Till & Morawetz, *Hyptis Blanchetii* Benth., and possibly *Kielmeyera reticulata* Saddi.

PHENOLOGY: Flowering material of *Erythroxylum Leal-costae* has been collected in late March and fruiting specimens in May.

COMMON NAMES AND USES: No common names or uses are reported for this species.

RELATIONSHIPS: *Erythroxylum Leal-costae* appears to be-long to Sect. *Rhabdophyllum* based on its having striated stipules, but its relationships within this large and diverse group are uncertain. *Erythroxylum Leal-costae* may be related to two other restinga species also occurring in Bahia: *E. passerinum* Mart. and an undescribed species (*Plowman & Carvalho 12795*). These two species are easily distinguished from *E. Leal-costae* by having more slender branchlets (ca. 2 mm. diameter), chartaceous leaves and longer pedicels (5–8 mm. long). Superficially, *E. Leal-costae* resembles several species of Sect. Archerythroxylum occurring in Brazilian restingas and related habitats, including *E. ovalifolium*

Peyr., *E. nitidum* Spreng. and *E. hypoleucum* Plowman. These may all be readily distinguished from *E. Leal-costae* by their lack of stipular striations.

Erythroxylum (sect. *Archerythroxylum)* **occultum** Plowman, *sp. nov.*

Arbor parva. Trunci cortex griseus, longitudinaliter et transversaliter profunde fissuratus. Ramuli recti, lenticellis abundanter producti. Stipulae persistentes, estriatae, nigrescentes, leviter fimbriatae, 3–setosae. Folia persistentia, breviter petiolata; laminae ellipticae vel oblongae, apice retusae, margine undulatae, basi cuneatae, chartaceae, elineatae. Flores 1–2 in axillis ramulorum hornotinorum producti, pedicellati. Petali lamina plus minusve plana, oblongo-elliptica. Urceolus stamineus quam calyx paulo brevior, ad marginem integer. Drupa oblongo-ellipsoidea, apice rotundata, rubra, endocarpio oblongo-ellipsoideo, 6–sulcato, ad maturitatem uniloculari.

TREE to 12 m. tall, with trunk reaching 35 cm. in diameter (*fide* Coimbra). BARK on trunk of young tree roughish, irregularly finely mottled with corky warts and fissures, dark reddish brown; in mature tree deeply fissured transversely and longitudinally forming quadrangular plates, dark grey (*fide* Coimbra). BRANCHES ascending, spreading, somewhat storied, terete, brown. BRANCHLETS distichous, consisting mainly of long shoots, straight, diverging 45°–60° from axis, flattened toward apex, 1.5–2.0 mm. in diameter, reddish brown, turning dark brown or dark grey with age, covered with numerous punctate or briefly elongate whitish lenticels. INTERNODES 2–18 mm. long. RAMENTA produced briefly at base of shoots for 5–8 mm. along stem, equaling the stipules. STIPULES persistent, appressed, somewhat incurved with age, oblong to narrowly ovate, 1.2–2.3 mm. long, firmly membranaceous, estriate, pale green, turning dark brown or black with age, apically rounded to truncate, 3–setose, the setae subfilamentose, early caducous, the 2 lateral setae 1 mm. long, the medial seta 0.5–0.8 mm. long, the keels slender, filamentose when young, the margin fimbriate when young, becoming entire and somewhat involute with age. LEAVES persistent, scattered on longer branchlets or 2–3 produced near

apex of shorter branchlets, distichous, petiolate, the lamina plane or somewhat undulate, elliptic to oblong, rarely oblong-obovate or lanceolate, apically retuse, strongly undulate at margin, basally cuneate, 25–55 mm. long, 15–25 mm. wide, chartaceous, medium green adaxially, pale green abaxially, somewhat shiny adaxially, dull abaxially, elineate, the central panel abaxially faintly demarcated by more prominent and more densely reticulate veinlets, the adaxial midrib slightly raised, slender, narrowly acute in cross section, yellowish green, the lateral nerves 8–11 per side, rather straight or arcuately curved, diverging 55°–80° from midrib, prominulous adaxially, prominulous to obscure abaxially, the veinlets finely reticulate, distinct to rather obscure. PETIOLE 1.5–3 mm. long, 0.4–0.8 mm. in diameter, green, drying dark brown, semi-circular in cross section, adaxially canaliculate. FLOWERS 1–2 in axils of mature current season's twigs, more or less scattered, the flower color unknown. BRACTEOLES 3 per flower, small, broadly triangular, 0.5–0.6 mm. long, membranaceous, early disintegrating, apically obtuse to acuminate, 1 setulose, the seta 0.5 mm. long, early caducous. PEDICEL slender, pentangular, 5–6 mm. long, 0.7–0.8 mm. in diameter. CALYX 1.5 mm. long, deeply divided, the lobes ovate, 1.0–1.3 mm. long, apically obtuse to short acuminate with an obtuse acumen. PETAL LAMINA spreading, more or less plane, oblong-elliptic, rounded at apex, 2.0 mm. long, 1.5 mm. wide, the claw 0.5 mm. long, the ligule 0.9 mm. long, trilobulate with 2 longer lateral lobes and 1 shorter medial lobe, the lobes broadly ovate, apically rounded. STAMINAL CUP about 3/4 the length of calyx, 0.7 mm. long, the margin entire. BRACHYSTYLOUS FLOWERS: filaments 2.0–2.5 mm. long; anthers not seen; styles free, 1 mm. long, reflexed in young fruit; stigma depressed-capitate, 0.3 mm. long. DOLICHOSTYLOUS FLOWERS: not seen. OVARY: not seen. DRUPE oblong-ellipsoid, rounded at apex, 11–14 mm. long, 7–8 mm. in diameter, red at maturity (*fide* Coimbra), the mesocarp 0.3–0.8 mm. thick, the endocarp oblong-ovoid, 6–sulcate, unilocular, the endosperm occupying about 1/2 of locule; some fruits abnormal, gall-infested. EMBRYO 9 mm.

long; cotyledons elliptic, flattened, apically rounded, basally subcordate, 8 mm. long, 4.8 mm. wide, 1 mm. thick; radicle 1.8 mm. long, terete.

TYPE: BRAZIL: STATE OF RIO DE JANEIRO: City of Rio de Janeiro. Matta do Horto Florestal. Árvore de 8 12 m. de altura. Matta. 28 Dec 1926 (fr), *Pessoal do Horto Florestal s.n., Herbario do Serviço Florestal do Brasil 223* (HOLOTYPE, RB 4842; ISOTYPES, RB 4842, 4 sheets; F 1875198, 3 isotypes to be distributed).

ADDITIONAL SPECIMENS EXAMINED: BRAZIL: RIO DE JANEIRO: City of Rio de Janeiro, Alto do Boa Vista, Estrada da Vista Chinesa, Centro de Botânica FEEMA-DECAM, cultivated in front of herbarium building, 26 Feb 1983 (st), *T. Plowman 12952* (F, GUA, RB, 3 duplicates to be distributed). This tree was originally discovered growing in the forest margin at the Parque da Cidade (Parque Federal da Gávea) in the city of Rio de Janeiro by Adelmar Faria Coimbra Filho who collected seeds for propagation and distribution at the former Instituto da Conservação da Natureza of the city of Rio de Janeiro.

ETYMOLOGY: From Latin "occultus," meaning "hidden," "concealed" or "secret." The name refers to the fact that this species had been overlooked previously by botanists, apparently due to its rarity.

DISTRIBUTION: *Erythroxylum occultum* is known only from the city of Rio de Janeiro.

ECOLOGY: This species grows in the moist tropical forests that surround the city of Rio de Janeiro. A. F. Coimbra Filho (pers. comm.), who introduced *E. occultum* into cultivation, asserts that it is an exceedingly rare species which may be in danger of extinction if it is in fact confined to the environs of the city of Rio. However, it may occur elsewhere in the Serra do Mar region and have been overlooked by collectors because of its rather small, inconspicuous flowers and possibly short flowering period.

PHENOLOGY: The only known fertile collection was made in late December. The tree cultivated at the Centro de Botânica in Rio (*Plowman 12952*) was 6 m. tall in 1983 and at least 15 years old but has never been observed to flower.

COMMON NAME: "Arco-de-pipa," a name that is also applied to *Erythroxylum pulchrum* St. Hil., a common tree species around Rio de Janeiro.

RELATIONSHIPS: *Erythroxylum occultum* belongs to section *Archerythroxylum*, a group that is well represented in southeastern Brazil with more than 20 species. Whereas its specific relationships are less clear, it appears to be related to both *E. vacciniifolium* Mart. (including *E. amplifolium* [Mart.] O. E. Schulz) and *E. cuspidifolium* Mart. (including *E. exaltatum* Bong. ex Peyr.), shrubs or small trees occurring in montane forests and restingas of the Serra do Mar. *Erythroxylum vacciniifolium* differs from *E. occultum* in having plane, more coriaceous leaves with dense and prominent venation, ramenta much larger than the stipules, coriaceous and up to 5 mm. long, a denticulate staminal cup and a smaller fruit (8–11 mm. long vs. 11–14 mm. long). *Erythroxylum cuspidifolium* differs in having larger (50–120 mm. long), apically acuminate leaves, smooth stipules, and flowers produced in dense fascicles at the tips of short shoots. *Erythroxylum occultum* also may be confused with species that have been placed in closely related sections (*fide* Schulz, 1907) and that also occur in the environs of the city of Rio de Janeiro. It differs from *E. cryptanthum* O. E. Schulz (sect. *Megalophyllum*) in having much smaller leaves (25–55 mm. vs. 50–105 mm. long), fimbriate stipules and longer pedicels (5–6 mm. vs. 2–3 mm. long); from *E. cincinnatum* Mart. (sect. *Microphyllum*) in its arborescent habit and in having the leaves dull on the lower surface, fimbriate stipules, more lax and fewer ramenta, longer pedicels (5–6 mm. vs. 1–2 mm. long) and an entire staminal cup; and from *E. pulchrum* St. Hil. (sect. *Leptogramme*) in having smaller leaves (25–55 mm. vs. 65–112 mm. long), shorter (1.2–2.3 mm. vs. 4–5 mm. long), fimbriate stipules and fewer flowers per node (1–2 vs. 6–20).

Erythroxylum (sect. *Archerythroxylum*) **hypoleucum** Plowman, *sp. nov.*

Arbor parva ramulis crassis griseis, innovationibus cera vestitis. Stipulae subcoriaceae, persistentes, estriatae, minute 2-setulosae. Folia breviter petiolata; laminae ellipticae, oblongae vel

obovatae, apice rotundatae retusae, coriaceae, supra viridia, subnitidae, subtus albae. Flores subsessiles, fasciculati in axillis foliorum vel ramentorum a ramulis annotinis producti, pedicello brevissimo crasso. Petali lamina concava, late ovata. Urceolus stamineus calyce dimidio brevior vel calycem aequans, ad marginem integer. Drupa ellipsoidea, endocarpio ellipsoideo-fusiformi, 6–sulcato, triloculari, loculis sterilibus 2, loculo fertili 1 cruciformi in sectione traversali, embryone valde compresso, cotyledonibus oblongo-ovatis.

Small TREE to 8 m. tall. TRUNK to 10 cm. in diameter with red inner bark. BRANCHES terete, grey to greyish brown, rather smooth, sometimes with warty "knobs" at intervals (remnants of past inflorescences). BRANCHLETS weakly distichous, consisting of both long and short shoots but not strongly dimorphic, diverging at 45° –75° from axis, somewhat flattened toward apex, thick, rather rigid, 2.5 4 mm. in diameter, reddish brown, covered with a waxy coating when new, sparsely provided with small, punctate, whitish lenticels, with age becoming light to dark grey or greyish brown. INTERNODES 2 14 mm. long on long shoots, 1 -3 mm. long on short shoots. RAMENTA absent or sparse, when present appearing at base of long shoots 7 10 mm. along axis, ca. 2.5 mm. long, black. STIPULES persistent but wearing away with age, appressed to stem and spreading with age, covered with waxy coating when new, triangular to ovate, 2 4 mm. long, subcoriaceous, estriate, light green, turning black with age, apically obtuse to acutish, minutely 2–setulose, the setae 0.2–0.3 mm. long, early caducous and rarely observed, the keels sub-alate, minutely fimbriate, some becoming entire, the margins minutely fimbriate, becoming entire with age. LEAVES persistent, scattered on long shoots or 1–3 produced at tips of branchlets, distichous, short petiolate, the lamina plane, elliptic to oblong or broadly obovate, apically rounded and shallowly retuse, with a minute black punctate mucron, revolute at margin, rounded to broadly cuneate at base, 40 90 (155) mm. long, 27 55 (70) mm. wide, subcoriaceous to coriaceous, adaxially light to dark green, sometimes glaucescent or slightly shiny, abaxially whitish or silvery, matt, bilineate with one distinct lateral line 5 8 mm. from each side of midrib, the central panel weakly distinct,

sometimes darker in color and with less prominent venation, the midrib flat and slightly impressed on adaxial surface, the lateral nerves 11–15 per side, straight or somewhat sinuous, diverging 45° 70° from midrib, prominent on both surfaces, the veinlets irregularly reticulate, sometimes obscure on upper surface. PETIOLE 3 6(8) mm. long, 1.5 2 mm. in diameter, covered with a waxy coating when young, subterete, adaxially canaliculate, subalate at margin. FLOWERS subsessile in axillary fascicles in axils of ramenta or leaves on past seasons' branchlets, with 2–5 flowers per node; petal lamina greenish with white margins, the ligule and filaments white. BRACTEOLES 3 per flower, triangular to broadly ovate, 0.5 1.2 mm. long, firmly chartaceous, apically obtuse to acutish, minutely l setulose, persisting and giving older branchlets a warty appearance. PEDICEL very short, thick, weakly pentangular, 0.3–0.8 mm. long, 0.5–1.0 mm. in diameter. CALYX subcoriaceous, 1.5–2.0 mm. long, divided 1/2 to 3/4 its length, the lobes ovate to triangular-ovate, acute to short acuminate at apex, 1.0–1.5 mm. long. PETAL LAMINA spreading or suberect, shallowly cymbiform to concave, broadly ovate in outline, apically obtuse to broadly rounded, 1.5–2.3 mm. long, 1.0 1.5 mm. wide, the claw 0.7–1.2 mm. long, the ligule 0.8–1.2 mm. long, consisting of 2 longer posterior lobes with a short basal thickening between them and 2 short anterior lobes. STAMINAL CUP half as long to nearly equaling the calyx, 0.5 1.2 mm. long, entire at margin; anthers suborbicular, basally cordate. BRACHYSTYLOUS FLOWERS: filaments 1.8–2.0 mm. long, the anthers 0.5 mm. long; styles free, 0.7–0.8 mm. long, deflexed somewhat after anthesis; stigma depressed-capitate, 0.3 mm. long. DOLICHOSTYLOUS FLOWERS: antesepalous filaments 0.4 0.5 mm. long, the anthers slightly smaller, 0.3–0.4 mm. long; styles free or coherent briefly at base, erect, 2.0–2.5 mm. long; stigma erect, depressed-capitate, 0.3 mm. long. OVARY ellipsoid-oblongoid, rounded to somewhat truncate at apex, slightly longer than staminal cup, 1.3–1.5 mm. long. DRUPE ellipsoid, apically obtuse to rounded, 7.5–8 mm. long, 3.0–4.5 mm. in diameter, dark red at maturity, the mesocarp to 0.5 mm. thick, the endocarp ellipsoid-fusiform, 6–sulcate, 3–locu-

lar at maturity, with 2 empty and 1 fertile locules, the fertile locule cruciform in cross section, the endosperm occupying about 3/4 of fertile locule. EMBRYO strongly compressed, green, 5.5 mm. long; cotyledons oblong-ovate, apically rounded, 3.3 mm. long, 1.4 mm. wide, 0.2 mm. thick; radicle 2.5 mm. long.

TYPE: VENEZUELA: Territorio Federal Amazonas: 1 km. al este de Maroa, sabana de arena blanca y bosque enano, Lat. 2°45′N., Long. 67°35′W., alt. 125 m., small shrub 3 m. tall; leaves subcoriaceous, deep green above, silvery below; flowers greenish white. 20 Apr 1970 (fl), *J. A. Steyermark et G. Bunting 102807* (HOLOTYPE, F 1848445; ISOTYPES, MO 2685581, VEN).

ADDITIONAL SPECIMENS EXAMINED: VENEZUELA: BOLÍVAR: Cumbre del Cerro Guaiquinima, a lo largo del afluente del río Carapo, 1 km. río arriba del Salto Szczerbanari, 5°44′4″ N., 63°41′8″ W., parte suroriental del cerro, alt. 730–750 m., 23–24 May 1978 (fr), *J. A. Steyermark et al. 117224* (F, VEN). TERRITORIO FEDERAL AMAZONAS: Dept. Casiquiare, Río Guainía, alrededores de Maroa, alt. ca. 127 m., 6–19 Jul 1969 (fl), *G. S. Bunting et al. 3996* (MY, U); Dept. Río Negro: San Carlos de Río Negro, 17 Sept 1975 (st), *P. E. Berry 1345* (VEN); 1–2 km. southeast and east of San Carlos de Río Negro, ca. 20 km. south of confluence of Río Negro and Brazo Casiquiare, 1°56′ N., 67°03′ W., alt. 120 m., 22 Apr 1979 (st), *R. L. Liesner 6859* (F), 2 Mar 1979 (fl), *H. L. Clark 7107* (VEN), 8 Feb 1980 (fl), *H. L. Clark 7341* (VEN); km. 11 de la carretera San Carlos de Río Negro-Solano (área de estudio del I.V.I.C.), alt. ca. 120 m., 16 Sept 1980 (st), *O. Huber et al. 5672* (F, VEN), *5691* (F, VEN); Mari's bana, 10.8 km. northeast on Solano road, n.v. "palo de máguari," 19 Aug 1981 (fl, fr), *H. L. Clark 8127* (F), *8129* (F), *8130* (NY), *8131* (F); 22 Sept 1975 (fl), *P. E. Berry & E. Brünig 1482* (VEN); 4.3 km. north-northeast on Solano road, phenology transect, plant #133, n.v. "palo de máguari," 28 Sept 1978 (fr), *H. L. Clark 6825* (NY), 11 Dec 1980 (fr), *H. L. Clark & P. Maquirino 7781* (F). BRAZIL: AMAZONAS: Alto Rio Negro, Rio Uaupés, Taracuá, Quadra 2–4, n.v. "turí," Feb 1959 (st), *W. Rodrigues 1132* (INPA); Taracuá, Feb 1959 (st), *J. M. Pires et al. 7527* (IAN), 29 May 1962 (fl), *J. M. Pires & N. T. Silva 7910* (IAN, UB); Rio Uaupés, n.v. "coca de caatinga," 11 May 1942 (st), *R. Froes 12576/300* (A, 2 sheets).

ETYMOLOGY: From Greek, "hypoleukos," meaning "white beneath," referring to the conspicuously white lower surface of the leaves.

DISTRIBUTION: Known only from the upper Río Negro region of southern Venezuela and the Rio Uaupés of neighboring Brazil. One disjunct population is known from the summit of Cerro Guaiquinima in the State of Bolívar, Venezuela, some 550 km. to the northeast of the nearest populations in the Río Negro area.

ECOLOGY: *Erythroxylum hypoleucum* grows primarily in savanna-woodland formations on white sand soils known as "Amazonian caatinga" in Brazil and as "bana" in Venezuela: This area is classified according to the Holdrige Life Zone system as "tropical moist forest" and receives an average of 3400 3600 mm. of rainfall per year. However, because of the relatively poor white sand soils, the "caatinga" supports only a dwarf forest or savanna vegetation.

PHENOLOGY: *Erythroxylum hypoleucum* flowers between April and September; the fruits appear between August and December.

COMMON NAMES AND USES: At San Carlos de Río Negro, *E. hypoleucum* is known as "palo de máguari" or "máguari's tree." "Máguari" refers to a malevolent spirit known to local witch doctors, who apparently use the plant for medicinal or magical purposes (H. L. Clark, pers. comm.). The species also is called "cachito" or "palo gallineta" at San Carlos. "Gallineta" is a Venezuelan name for tinamous who probably eat the fruits of this tree. On the Rio Uaupés in Brazil, *E. hypoleucum* is called "turí."

RELATIONSHIPS: *Erythroxylum hypoleucum* is closely related to *E. lineolatum* DC. and probably has been derived from it. *Erythroxylum lineolatum* is an uncommon species with a scattered distribution across northern South America. It is known from the Cauca Valley in northwestern Colombia east to Trinidad and grows in a variety of habitats including dry scrublands, bush islands in savannas and moist cloud forest. *Erythroxylum hypoleucum* may be distinguished from *E. lineolatum* in having thicker branchlets (2 4 mm. vs. 1.5 2.0 mm. in diameter), more coriaceous leaves, and much thickened, shorter (0.3–0.8 vs. 2.0–5.0 mm. long) pedicels.

ACKNOWLEDGMENTS

Field studies of *Erythroxylum Leal-costae* and *E. occultum* in Brazil were supported largely by the Field Museum of Natural History. I would like to thank the following individuals and institutions for their cooperation and invaluable assistance in conducting this research: Pedrito Silva, Gustavo E. M. Almeida and Larry Noblick (Salvador, Bahia); André M. de Carvalho and L. A. Mattos Silva (CEPLAC, Itabuna, Bahia); J. Pedro P. Carauta and the staff of Centro do Botânico do Rio de Janeiro); Adelmar F. Coimbra Filho (Rio de Janeiro), Elsie Franklin Guimarães, Haroldo C. de Lima and Gustavo Martinelli (Jardim Botânico do Rio de Janeiro) and Dimitre Sucre (Rio de Janeiro). I am grateful to Julian A. Steyermark and Howard L. Clark for providing specimens of *Erythroxylum hypoleucum*. I am grateful to the curators of the following herbaria who kindly lent specimens essential to this study: A, ALCB, CEPEC, F, IAN, INPA, MO, NY, RB and VEN.

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PLATE 26

Plate 26. Dune scrub habitat and sprawling growth habit of young shrub of *Erythroxylum Leal-costae* Plowman *(Plowman 12780)* near Itapuã, Bahia, Brazil.

PLATE 27

Plate 27. Close-up showing bark on major basal branch of *Erythroxylum Leal-costae* Plowman *(Plowman 12770)*.

PLATE 28

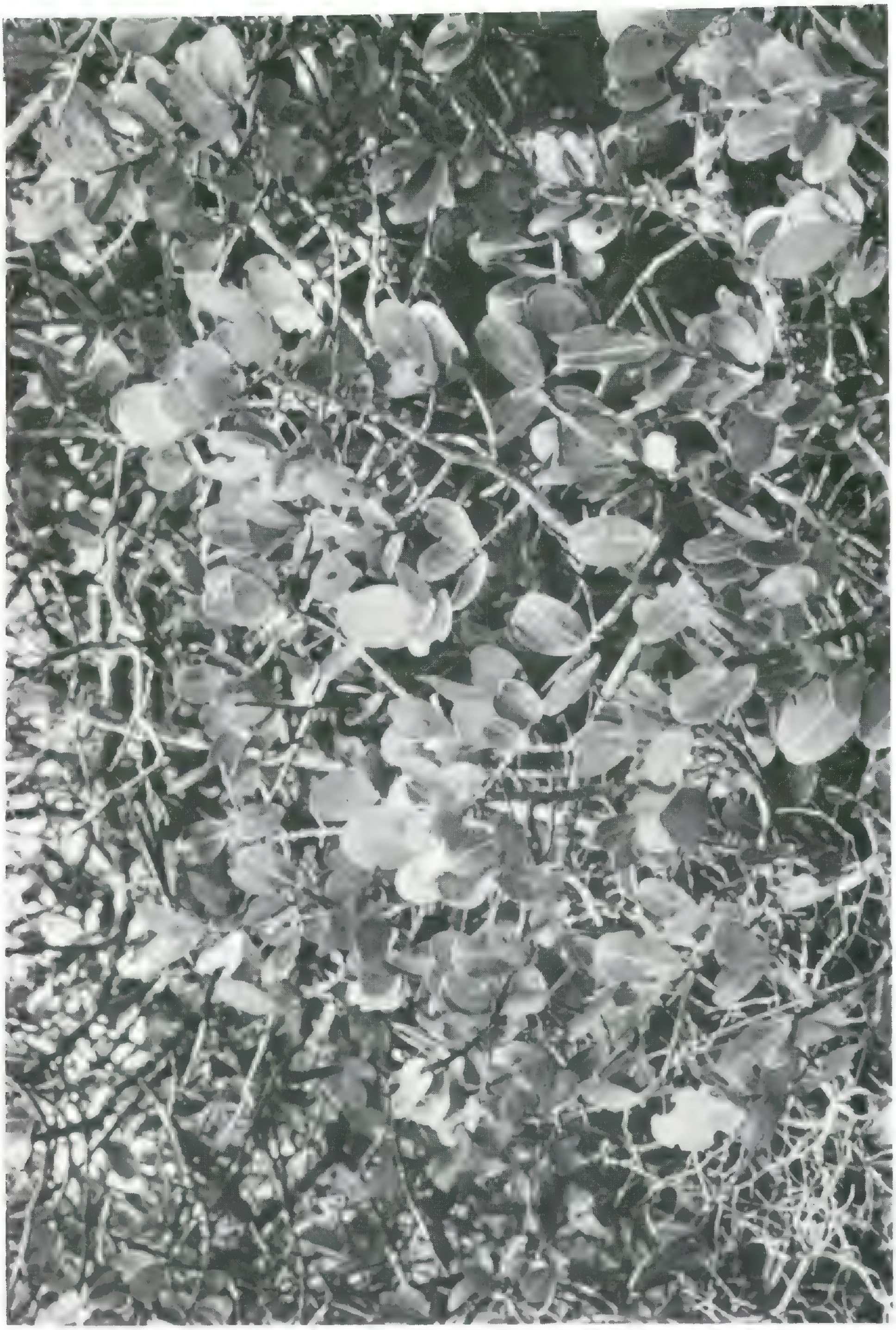

Plate 28. Densely branched habit of mature individual of *Erythroxylum Lealcostae* Plowman *(Plowman 12770).*

PLATE 29

Plate 29. Branching habit of *Erythroxylum occultum* Plowman, cultivated at Centro de Botânica, Alto de Boa Vista, Rio de Janeiro, Brazil *(Plowman 12952)*.

PLATE 30

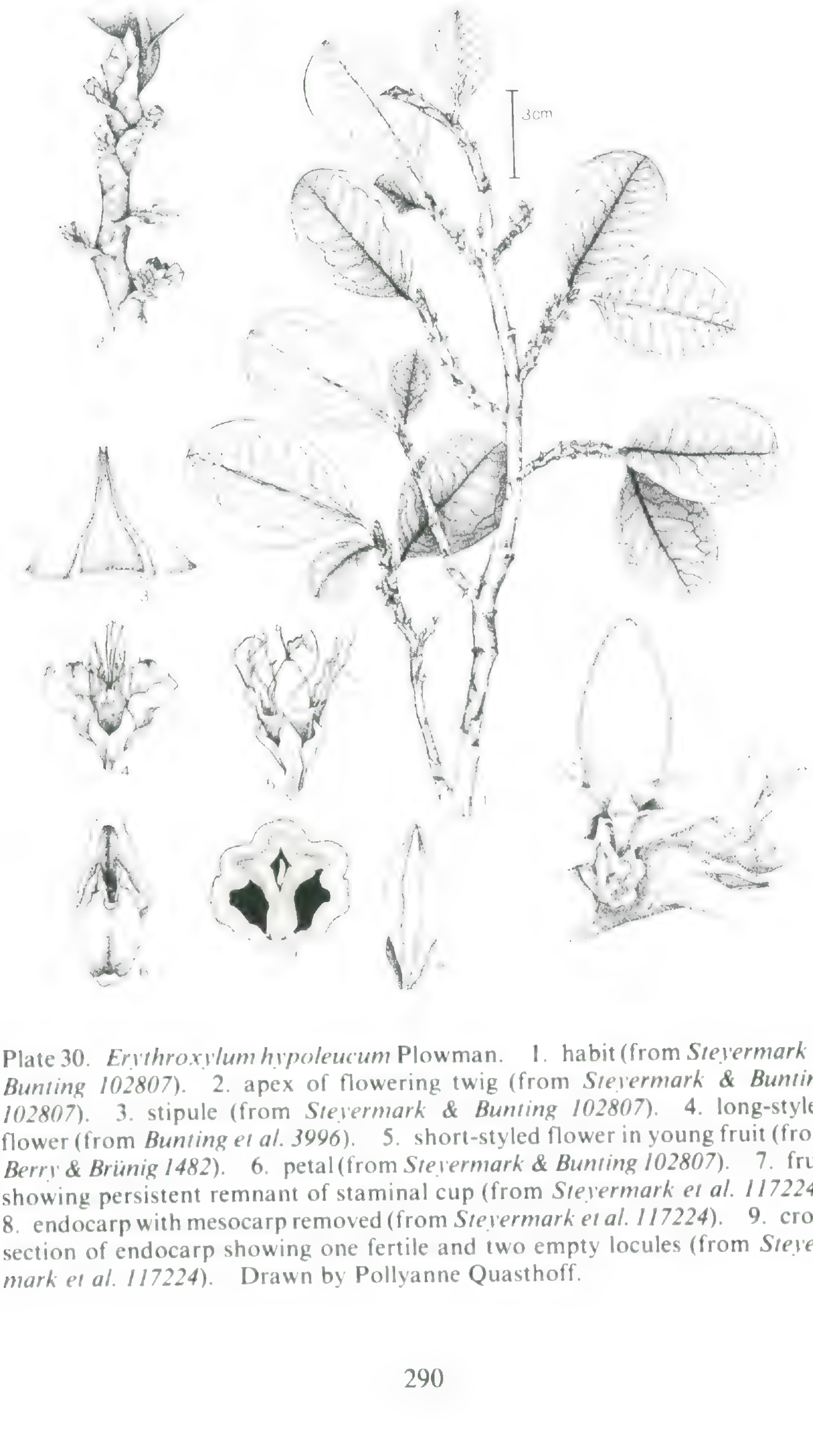

Plate 30. *Erythroxylum hypoleucum* Plowman. 1. habit (from *Steyermark & Bunting 102807*). 2. apex of flowering twig (from *Steyermark & Bunting 102807*). 3. stipule (from *Steyermark & Bunting 102807*). 4. long-styled flower (from *Bunting et al. 3996*). 5. short-styled flower in young fruit (from *Berry & Brünig 1482*). 6. petal (from *Steyermark & Bunting 102807*). 7. fruit showing persistent remnant of staminal cup (from *Steyermark et al. 117224*). 8. endocarp with mesocarp removed (from *Steyermark et al. 117224*). 9. cross section of endocarp showing one fertile and two empty locules (from *Steyermark et al. 117224*). Drawn by Pollyanne Quasthoff.

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NOVEL HALLUCINOGENS FROM EASTERN ECUADOR

E. WADE DAVIS AND JAMES A. YOST*

Recent ethnobotanical investigations have greatly advanced the scientific understanding of the identification, distribution and constituents of plant hallucinogens in the northwest Amazon. To date at least nineteen species employed as stimulants or narcotics have been reported from this region—a figure that represents approximately one-seventh of all known psychotomimetic plants (Schultes and Hofmann 1980). Although this remarkable concentration in part reflects floristic peculiarities, it is also a result of cultural characteristics of the indigenous tribes. Throughout the northwest Amazon, hallucinogenic plants are a very vital feature of religious, medical and magical aspects of life.

In the spring of 1981, whilst we were engaged in ethnobotanical studies in eastern Ecuador, our attention was drawn to a most peculiar use of hallucinogens by the Waorani, a small isolated group of some 600 Indians (cf. Davis and Yost, in press). Amongst most Amazonian tribes, hallucinogenic intoxication is considered to be a collective journey into the subconscious and, as such, is a quintessentially social event (Harner 1973, Reichel Dolmatoff 1971, 1975). The Waorani, however, consider the use of hallucinogens to be an aggressive anti-social act; so the shaman, or *ido,* who desires to project a curse takes the drug alone or accompanied only by his wife at night in the secrecy of the forest or in an isolated house. Under the influence of *mii* (*Banisteriopsis muricata* (Cav.) Cuatr.) the *ido* can call on the *wenae,* or malevolent spirits, to wreak evil, but there are no spirits whom he can contact to do good or to counter another *ido's* curse. This belief is an unusual exception to the Amazonian pattern in that only the *ido* who caused the calamity can cure it, which he does by drinking *mii* to communicate with his *wenae* to convince them to

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withdraw from the victim. It places the shaman in a precarious position, in that any agreement by the shaman to cure is a *de facto* admission of guilt; to agree to cure could easily end in death, so the accusation of being an *ido* is one that is usually met with defiant denial. Given this belief system, it is easy to see why the *ido* would inevitably choose to act clandestinely.

Of particular botanical interest is the fact that this peculiar cultural practise involves hallucinogenic plants, one rarely used and one until now unreported. The Waorani have two hallucinogens: *Banisteriopsis muricata* and an as yet undescribed basidiolichen of the genus *Dictyonema*. The former is morphologically very similar to other commonly used psychoactive malpighiaceous species such as ayahuasca, *Banisteriopsis Caapi* (Spr. ex. Griseb.) Morton. On the other hand, no basidiolichen has yet been reported to be employed as a hallucinogen.

Mii, (Banisteriopsis muricata) is the only hallucinogenic plant currently used by the Waorani. Although both of our collections (*Davis et Yost 967; 975*) were made on the edge of chacras (cultivated plots), the Waorani maintain that the plant is not cultivated and frequently point it out growing wild along the river banks.

The *ido* prepares the drug by scraping the bark of the liana and slowly boiling the brew; a procedure not unlike that followed in the preparation of *B. Caapi* as reported from elsewhere in the Amazon. Although only the shaman imbibes the drug, all adult Waorani clearly associate certain powers with it. A boy's uncle or grandfather may take a tiny piece of the liana and, using the windpipe from a toucan, piping guan or curassow as a blowgun, blow the wadded *mii* into the boy's lungs so that he will grow up to have powerful lungs and become a great hunter.

Banisteriopsis muricata has never been studied pharmacologically (García Barriga 1975), but it almost certainly contains psychoactive constituents. The Witoto of Pucu Urquillo on the Río Ampiyacu in Peru call this species *sacha ayahuasca*—"wild ayahuasca"—and say that it can be used in the same way as ayahuasca (*B. Caapi*), but that it is weaker.

The second hallucinogen recognised by the Waorani is a conspicuous but extremely rare species of lichenized basidiomycete.

It is a peculiar plant with a white hymenial layer and a bright green/blue upper surface. Dr. Mason Hale of the Smithsonian Institution has studied our collection (*Davis et Yost 1051*) and has suggested that it represents a new species of *Dictyonema*. Our Waorani informants called it nɇnɇndapɇ, a name which they apply to many fungi, but they insisted that this plant was once used in shamanistic ritual. It was last used some four generations ago—approximately eighty years—when "bad shaman ate it to send a curse to cause other Waorani to die". The drug was prepared as an infusion with various species of Bryophyta—*kigiwai*—and caused severe headaches and confusion when it was drunk.

Nɇnɇndapɇ is also reported to cause sterility and may be put into a child's drink to cause barrenness. At the moment, it is unclear whether this is a *post-hoc* explanation of why some women are sterile or whether it indicates the presence of active chemical constituents. Although no peculiar lichen acids have been reported from *Dictyonema*, the genus is very poorly known and certainly deserves phytochemical investigation. It may be difficult to gather adequate supplies for analysis; so rare is this species in Waorani land that one of us (JY) heard references to it for over seven years before encountering it in the forest.

We wish to acknowledge gratefully the generous support of the Social Science and Humanities Research Council of Canada and the Interamerican Foundation and the Summer Institute of Linguistics. In Ecuador, we received the full cooperation of the herbarium staffs of the Universidad Central and the Universidad Católica. The staff and field personnel of the Summer Institute of Linguistics offered crucial logistical support. We would especially like to thank Dr. Timothy Plowman of the Field Museum of Natural History, Dr. Mason Hale of the National Museum of Natural History, Smithsonian Institute, and Prof. Donald Pfister of the Farlow Herbarium of Harvard University for their assistance with the determination of the specimens and Prof. Richard Evans Schultes of the Botanical Museum of Harvard University for reviewing the manuscript. Voucher specimens are on deposit at the Economic Herbarium of Oakes Ames and the Farlow Herbarium, both of Harvard University.

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PLATE 31

Plate 31. *Dictyonema* sp. nov. Det. Mason Hale.

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MORPHOLOGICAL STUDIES OF ARCHEOLOGICAL AND RECENT COCA LEAVES (*ERYTHROXYLUM* SPP.)

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INTRODUCTION

Coca leaves, derived from two closely related species of the genus *Erythroxylum* P. Br., are widely used in South America as a masticatory and in household medicine. The history of coca chewing dates back several thousand years and there is evidence that coca is one of the oldest domesticated plants in the New World (Plowman, in press). Coca continues to be an important cultural feature among indigenous peoples throughout the Andes and in the western Amazon. In recent years, the cultivation of coca has greatly increased in order to supply the great demand for the alkaloid cocaine, which has become an extremely popular recreational drug in Western societies.

In spite of its great antiquity, the history and botany of coca have not been studied in depth until the past decade. Although

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coca was formerly considered to be derived from the single species *Erythroyxlum Coca* Lam., modern studies have demonstrated that two distinct species are involved: *E. Coca* Lam. and *E. novogranatense* (Morris) Hieron. In addition, each of the two species has a distinct variety, so that four cultivated cocas are now recognized: *E. Coca* Lam. var. *Coca, E. Coca* var. *Ipadu* Plowman, *E. novogranatense* (Morris) Hieron. var. *novogranatense* and *E. novogranatense* var. *truxillense* (Rusby) Plowman (Plowman 1979a, b, 1981, 1982; Rury, 1981, 1982; Bohm, Ganders & Plowman, 1982; Plowman & Rivier, 1983; Plowman, in press). The present distribution of the four varieties is shown in Plate 32.

All four of the cultivated cocas were domesticated in pre-Columbian times and are still employed by native coca chewers in South America. Each was known by a different name before the Spanish popularized the now widespread term "coca". All of the cultivated cocas contain cocaine, although they are now known to differ appreciably in their content of minor alkaloids and other chemical constituents (Bohm, Ganders & Plowman, 1982; Plowman & Rivier, 1983). Additional important differences among the four varieties, which hitherto had been overlooked, are found in their leaf and stem anatomy, ecology, geographical distribution, breeding relationships, as well as in their cultivation and preparation for chewing. These differences have arisen through intensive human selection over a long period of time for desirable traits and for adaptations which permit coca cultivation in a wide variety of habitats.

Erythroyxlum Coca var. *Coca,* "Huánuco" or "Bolivian" coca, is thought to be the most nearly ancestral type and today is still found in a wild or feral state throughout the moist tropical forests ("*montaña*") of the eastern Andes of Peru and Bolivia. It is also extensively cultivated today as the most important commercial source of coca leaves and cocaine.

Amazonian coca, *E. Coca* var. *Ipadu,* is cultivated in the lowland Amazon by a number of tribes of shifting agriculturalists. It apparently has been derived relatively recently as a lowland cultigen from *E. Coca* var. *Coca* of the Andean foothills, and does not persist as a feral plant in the forests of

Amazonia. Amazonian coca leaves are always finely pulverized before use in contrast to other varieties in which the whole leaf is chewed (Plowman, 1981; Schultes, 1981).

Trujillo coca is classified as *E. novogranatense* var. *truxillense,* based upon its morphology, ecology and alkaloid and flavonoid chemistry. It is, however, intermediate in a number of characteristics between *E. Coca* var. *Coca* and *E. novogranatense* var. *novogranatense* and may represent a stage in a linear evolutionary sequence between these two taxa (Bohm, Ganders & Plowman, 1982). Trujillo coca is well adapted to dry areas and shows remarkable resistance to drought. Today it is grown only in the river valleys of north coastal Peru and in the arid valley of the upper Río Marañón, with one disjunct population in northwestern Ecuador (Plowman, 1979b). It is not found anywhere in a wild or feral state and must be considered a true cultigen. Trujillo coca probably evolved under domestication from *E. Coca* var. *Coca* in the drier valleys of northern Peru or southern Ecuador and only later diffused to coastal Peru.

Colombian coca, *E. novogranatense* var. *novogranatense,* is cultivated in both wet and dry areas in the mountains of Colombia but, like Trujillo coca, exhibits tolerance to drought. It is also identical to Trujillo coca in its alkaloid and flavonoid chemistry (Bohm, Ganders & Plowman, 1982; Plowman & Rivier, 1983). Unlike the other cultivated varieties, Colombian coca is partially self-compatible and appears to be the evolutionarily most derived species.

Dating of the time of divergence of the species and varieties of cultivated coca has not yet been possible. Application of techniques of biochemical genetic markers may prove useful toward this end but have not yet been investigated in *Erythroxylum.* A second approach, which has been useful in unraveling the early evolutionary history of many domesticated plants, is the study of dated archeological remains.

ARCHEOLOGICAL COCA

The early evolution of coca in light of archeological evidence recently has been reviewed in detail by Plowman (in press). The

first evidence for coca chewing appears in the Valdivia culture on the Santa Elena Peninsula in southwestern Ecuador in the form of small, ceramic lime containers, dating about 2000 B.C. A small figurine representing a coca chewer was also found here and dates to Late Valdivia (1500–1600 B.C.) (Lathrap et al., 1976). More recent artifacts from Ecuador, Colombia and Peru demonstrate a long and continuous tradition of coca chewing (Bray & Dollery, 1983; Plowman, in press).

Archeological specimens of actual coca leaves are extremely scarce, often poorly preserved, and usually lack stratigraphic or carbon-14 dates. In many cases, leaves reputed to be coca from archeological sites have not been preserved by archeologists for later examination and verification by specialists. As a result, many critical specimens are now completely lost or discarded.

Most specimens of archeological coca originate from the dry Peruvian coast, where preservation of plant remains is optimal. The first suggestion of archeological coca dates to the end of the Late Preceramic Period 6 (1800–2500 B.C.). Engel (1963) found leaves "looking like coca" along with large deposits of burnt lime (presumably used as an alkaline catalyst in coca-chewing) at the site of Asia in the Omas Valley in central Peru. Asia is radiocarbon-dated at about 1300 B.C. but probably dates to about 1800 B.C. (M. Moseley, pers. comm.). Engel's report of coca at this early site must be considered dubious since the specimens no longer exist. Patterson (1971) excavated preserved coca leaves at Las Gaviotas near Ancón, a site dated between 1750 and 1900 B.C.; Cohen (1978) also reported coca from Ancón with a date of 1400–1800 B.C. Coca leaves were also one of the items (along with maize and marine shells) stockpiled in a group of storage structures at Huancayo Alto in the Chillón Valley, dating between 200–800 B.C. (Dillehay, 1979). None of these earliest records of archeological coca have been botanically identified.

Preserved coca leaves from much later sites on the Peruvian coast have been available for study and form the basis of the present investigation (Table 1). These include specimens from Vista Alegre in the Rimac Valley (ca. 600–1000 A.D.), which

were illustrated by Towle (1961, Plate IV: 5); from the Yauca Valley (Late Horizon, Plates 35 and 36); from Monte Grande in the Río Grande Valley and in the environs of Nazca ("Cultura Nazca"); from the Taruga Valley (Plates 33 and 34) and Ocucaje (Late Horizon) and at Chacota near Arica in northermost Chile (Inca Period).

Griffiths (1930) has made the only detailed anatomical study of archeological coca leaves from a grave at Nazca. Based on comparison with commercial coca leaves, she concluded that they belonged to the variety then known as "Peruvian" coca, an earlier pharmaceutical trade name for Trujillo coca. Our re-examination of her data and illustrations confirm the identity of her specimens as Trujillo coca, although we have not located her original material. Griffith's leaf illustrations conform entirely to our typological concept of Trujillo coca in both qualitative and statistical aspects of foliar size, form, venation and anatomy.

Towle (1952) reported "leaf tissue found rolled into a quid" in a mummy bundle from the Paracas Necropolis on the southern coast of Peru and noted that it "would suggest the leaves of coca (*Erythroxylum Coca* Lam.)." Towle was apparently unfamiliar with Griffith's earlier study and did not have authentic material of Trujillo coca for comparison. She concluded that the leaf fragments were "too small and brittle" to permit their botanical identification.

Coca endocarps from Nazca were identified by Griffiths (loc. cit.) as Trujillo coca, whereas those found at Vista Alegre were referred to "*Erythroxylum Coca*" by Towle (1961). More recently, endocarps were excavated at Chilca (Late Intermediate Period) by Jeffrey Parsons (pers. comm.). Although not included in the present study, all archeological coca endocarps which we have examined are referable to Trujillo coca.

In the present contribution, we examine the leaf morphology and anatomy of available archeological leaf specimens and compare them with modern samples of leaves of the cultivated cocas presently grown in South America. Because archeological material often provides only isolated or fragmented leaves, as noted by Towle (1952), it is essential to consider in detail the

microscopic features of coca leaves of each variety and compare them with the same characters in the archeological specimens.

As an aid to the identification of coca leaves and leaf fragments, we have summarized in Table 3 those structural details which are useful in the determination of cultivated coca leaf specimens. Details of foliar venation are presented in Table 4 and selected leaf anatomical features are presented in Table 5. A comprehensive review of taxonomically useful leaf structural features in *Erythroxylum* can be found in an earlier publication (Rury, 1981).

MATERIALS

Archeological coca specimens were obtained from the following museum collections: Ethnobotany Laboratory, Botanical Museum, Harvard University; Lowie Museum of Anthropology, University of California, Berkeley; and the Museo de Historia Natural 'Javier Prado', Lima, Peru. Additional specimens of archeological leaves were studied at the Peabody Museum of Archaeology and Ethnology, Harvard University, and of coca endocarps from the collection of Dr. Jeffrey Parsons. All of these specimens originated in coastal Peru or adjacent northernmost Chile; in most cases the leaves were included in woven coca bags found in burials. The specimens at the Museo de Historia Natural 'Javier Prado' were originally found in coca bags preserved at the Museo Regional de Ica, Peru. They were supplied by the director, Sr. Alejandro Pezzia A. to Dra. Maria Rostworowski, who in turn presented them to Dr. Ramón Ferreyra for identification (cf. Rostworowski, 1973: 205). The archeological coca specimens are listed in Table 1.

Recent specimens of cultivated coca varieties were taken from the herbarium specimens listed in Table 2. Location of voucher specimens (including duplicate specimens) are listed according to herbarium abbreviations suggested by Holmgren, Keuken and Schofield (1981). All recent coca specimens were determined by Plowman.

METHODS

Six archeological (Table 1) and thirty recent (Table 2) leaf specimens of the cultivated cocas were prepared for microscopic examination. All of these leaves were cleared in a 5% aqueous solution of NaOH, either at room temperature (archeological), or in an oven at ca. 70° C. (recent). Cleared leaves were stained with a 1% solution of safranin in 50% ethanol for several days, then dehydrated with ethanol, treated with xylene and mounted permanently on microscope slides in Canada balsam. Recent leaves also were prepared for paraffin sectioning by conventional methods of botanical microtechnique. To obtain epidermal sheets for stomatal examination and counts, leaf fragments were macerated in Jeffrey's macerating solution recipe from Johansen (1940).

Numbers of freely terminating veinlets and stomata per mm^2 of leaf surface were microscopically determined, using 10-20 counts per leaf or leaf fragment. Stomatal counts and maximum guard cell lengths were measured either from cleared leaves (archeological) and/or macerated leaf epidermal sheets (recent). In order to provide a reliable comparison of their stomatal systems, the stomatal density (i.e. number per mm^2) was corrected for relativistic differences in guard cell length among different specimens. Since stomatal size and relative number per unit of leaf area typically are inversely interrelated (Rury, 1981, 1982), it was necessary to calculate the percentage of leaf surface occupied by stomata (i.e. stomatal frequency) for comparative purposes. This calculation thus integrates guard cell length and stomatal density into a single, standardized measurement, which is especially useful when working with leaf fragments.

Leaf venation terminology has been simplified as much as possible, but follows that of Mouton (1970) and Hickey (1973) with necessary additions and modifications.

Illustrations were prepared using several techniques. Negative prints of foliar venation patterns of recent coca leaves were prepared by placing cleared leaf slides directly in the photographic enlarger (Dilcher, 1974). Line drawings of foliar

venation and epidermal patterns were made for all specimens, using a Wild dissecting microscope with a drawing attachment. Several black and white photomicrographs of high order leaf venation, in both archeological and recent specimens, were made with a Zeiss photomicroscope, either with or without polarizing filters.

RESULTS

Archeological Leaf Specimens (*Erythroxylum novogranatense* var. *truxillense*)

LEAF FORM: Leaves are relatively small in size, ranging from 23–40 mm. in length and 6–16 mm. in width. The leaf blade shape is mostly lanceolate, narrowly elliptic, or slightly oblanceolate. Leaf bases are typically cuneate, with acute and conspicuously mucronulate apices. The central panel, demarcated by abaxial (on lower surface), longitudinal lines along either side of the midvein, is usually faint or sometimes absent, but may be prominent and enclose a finer reticulum of less conspicuous venation when compared with the exmedial (outer) portions of the leaf blade.

LEAF VENATION: The primary vein (midvein) is moderately thick and follows a straight course from the leaf base to the apex. The basic vein pattern is only slightly variable, ranging between the eucamptodromous and brochidodromous configurations, with a festooned system of higher order, intramarginal, loop-forming veins (Plate 37).

The basic vein patterns derive their appearance from the course and behavior of the secondary veins, in relation to one another, the midvein and the leaf margin. Each leaf contains from 7–15 slender, secondary veins which typically diverge from the midvein at moderately to widely acute angles (45–80°) and follow a sinuous or smoothly upcurving course as they approach the leaf margin. These secondary veins then either (1) taper into a system of festooned, high order, intramarginal loops along the outer flanks of the superadjacent secondary veins (eucamptodromous) or (2) recurve towards the midvein and join the outer flanks of the superadjacent secondary veins to form a series of

secondary vein arches (brochidodromous). The intercostal areas demarcated by these secondary veins are moderately uniform in their size and shape. Intersecondary veins of composite origin from the coalescence of tertiary veins, although few in number (2–7 per leaf), may occur within the intercostal areas. Intramarginal veins of secondary origin are absent from all leaves examined.

Slender tertiary veins arise at widely acute to slightly obtuse angles (80–110°) along the inner and outer flanks of the secondary veins. These tertiary veins ramify towards the midvein and/or transversely within the intercostal areas to form a ramified, random reticulum of non-oriented, polygonal, tertiary areoles. These tertiary areoles are further subdivided by ramified fourth and fifth order veinlets into a random reticulum of many, moderately well developed and small, polygonal or quadrangular areoles. The mean number of freely terminating veinlets ranges between 16–30 per mm^2, with an overall mean of 22 per mm^2 (Table 4). Veinlet terminations are typically tracheoid with spiral or pitted secondary cell walls (Plate 38). Tracheoidal idioblasts and fibrous sclereids were absent from all leaf specimens examined. The marginal ultimate venation of these leaves consists of second through fourth order, loop-forming veins and veinlets, which promote the "festooned" appearance of the overall venation patterns.

EPIDERMIS: The epidermal cells of all leaves are polygonal in surface view, with straight walls. Cells of the upper epidermis are of uniform size but are consistently larger than those of the lower epidermis. Cells of the lower epidermis, however, may reveal a greater degree of size variation than those of the upper epidermis.

In all leaves, stomata are restricted to the lower surface and are strictly of the paracytic type, with one pair of subsidiary cells aligned parallel to the long axis of each stomate (Plate 37E, F). Guard cell lengths do not exceed 25μm in any of the stomata, and mean stomatal density ranges between 156–203 per mm^2, with an overall mean of 183 per mm^2 (Table 5). Stomatal frequency, calculated as the relative percentage of leaf surface

occupied by stomata, averages 11.4%, and specimen means range between 10–13% (Table 5).

Epidermal papillae are either absent (e.g. Nazca #8), sparse or prominent, but are consistently restricted to the lower epidermal cells (Plate 37D, E, F). Papillae are always absent from both the guard cells and their associated subsidiary cells of all stomata on the lower leaf surface.

CRYSTALS: Vein-associated prismatic or rhomboidal crystals of calcium oxalate are typically very abundant and may occur also in cells of either epidermal surface (Plate 38).

FOLIAR SCLEREIDS: No foliar sclereids of any type were observed in the archeological leaves examined.

Recent Leaf Specimens

LEAF FORM AND VENATION: Although leaves of the cultivated cocas may exhibit similar and intergrading forms and patterns of low and high order venation, a typological concept of leaf form and venation can be formulated for them. The leaf venation patterns which are considered "typical" for each of the cultivated cocas are summarized in Table 4. These diagnoses are based on observations of many more specimens than were prepared for microscopic study (Table 2), and microscopic examination was performed only on selected specimens which represent the full range of variability within each variety. Leaves of Amazonian coca (*Erythroxylum Coca* var. *Ipadu*) are not sufficiently distinct from those of *E. Coca* var. *Coca* in their leaf venation to warrant separate description. It should be noted, nevertheless, that particular leaf specimens may diverge from this overall diagnosis in details of both low and high order venation as well as in leaf form.

Leaves are small to medium in size, ranging from 20–115 mm. in length and 10–24 mm. in width. Leaves of Trujillo coca typically are the smallest, whereas those of Amazonian coca attain the largest sizes. All varieties of cultivated coca possess an acute or cuneate leaf base. Leaf shape varies both within and among varieties, but may be characterized as follows for each variety: (1) *E. Coca* var. *Coca,* broadly lanceolate to elliptic,

with an acute and conspicuously mucronulate apex; (2) *E. Coca* var. *Ipadu,* broadly elliptic, with an acute to obtuse, conspicuously mucronulate apex; (3) *E. novogranatense* var. *novogranatense,* oblong to oblong-elliptic (rarely obovate), with an obtuse to rounded or emarginate, rarely mucronulate apex; and (4) *E. novogranatense* var. *truxillense,* narrowly elliptic to lanceolate, with an acute, minutely mucronulate apex. Although foliar form is more or less diagnostic for particular coca varieties, the full range of variation among the leaves of the four varieties constitutes a continuum of shapes and sizes (Plate 39). Isolated leaves and leaf fragments, therefore, cannot be reliably identified on the basis of leaf form and size alone. A combination of both macro- and micromorphological features is required for accurate taxonomic identifications of coca leaves.

The central panel, demarcated by a pair of abaxial "lines" (anatomically, collenchyma ridges; Rury, 1981) running parallel to and on either side of the midvein, is of variable occurrence and prominence among the cultivated cocas. The central panel may be conspicuous, due to its markedly finer and less prominent vein reticulum in *E. Coca* var. *Coca* and *E. novogranatense* var. *novogranatense,* but often is very faint or entirely lacking in some leaves of *E. Coca* var. *Ipadu* and *E. novogranatense* var. *truxillense,* owing to overall uniformity of the vein reticulum throughout the leaf. Statistically significant differences may occur in both stomatal and veinlet termination numbers, within versus outside of the central panel, when this feature is prominent in leaves of each variety (Rury, 1982). Careful attention, therefore, must be given to the position in the leaf at which such data are gathered.

The primary vein (midvein) is of moderate diameter and follows a straight course from the leaf base into its apex. The basic venation patterns vary moderately, both within and among coca varieties, ranging from eucamptodromous to brochidodromous, with a festooned system of intramarginal, loop-forming veins and veinlets (Table 4). Leaves of *E. novogranatense* var. *truxillense* (Trujillo coca) are the most variable of all varieties in their overall venation pattern, which may range between the eucamptodromous type characteristic of both

varieties of *E. Coca* and the brochidodromous pattern typical of *E. novogranatense* var. *novogranatense.* As will be discussed in greater detail later, such extensive variation in leaf form and venation can usually be explained ecologically, in relation to differences in microhabitat experienced by individual leaves or plants, but it is also an indication of the intermediate nature of Trujillo coca between *E. Coca* var. *Coca* and *E. novogranatense* var. *novogranatense.*

Secondary veins of both varieties of *E. Coca* typically are numerous (15–40 per leaf), closely spaced and of moderate thickness. In both varieties of *E. novogranatense,* they are usually fewer (8–18 per leaf), more widely spaced and more slender (Plate 39). Secondary vein divergence angles from the midvein range between widely acute to perpendicular (80–90°, *E. Coca* vars., *E. novogranatense* var. *truxillense*) and narrowly to widely acute (40–80°, *E. novogranatense* var. *novogranatense,* some specimens of *E. novogranatense* var. *truxillense*). Secondary veins follow an initially straight, regular (*E. Coca* vars.) or sinuous (*E. novogranatense* vars.) course, and gradually upcurve as they approach the leaf margins. The subsequent branching behavior of these veins determines the basic configuration of the overall venation pattern. These secondary veins then either: (1) taper into a festooned system of high order, intramarginal loops along the outer flanks of the superadjacent secondary veins (eucamptodromous, *E. Coca* vars.) or (2) recurve admedially (inward towards midvein) near the margin and join these superadjacent secondaries at widely acute to obtuse angles (80–100°) to form a series of (secondary) vein arches (brochidodromous, *E. novogranatense* var. *novogranatense*). Secondary veins of *E. Coca* varieties and *E. novogranatense* var. *truxillense* normally are thicker, more prominent and more numerous than in leaves of *E. novogranatense* var. *novogranatense.* Secondary veins thus demarcate intercostal areas which are both more numerous and of greater uniformity in size and shape in leaves of *E. Coca* varieties and *E. novogranatense* var. *truxillense* than in most leaves of *E. novogranatense* var. *novogranatense.* Intersecondary veins of composite origin are very few, but when present they are most

numerous in the larger intercostal areas of *E. novogranatense* var. *novogranatense*. Intramarginal veins of secondary origin are absent from leaves of all varieties.

Slender tertiary veins arise at widely acute to slightly obtuse angles (80–100°) along the admedial (inner) and exmedial (outer) flanks of the secondary veins and ramify within the intercostal areas to form non-oriented, polygonal, tertiary areoles of various sizes. Tertiary areoles tend to be slightly smaller and most numerous in both varieties of *E. Coca*. Conversely, leaves of *E. novogranatense* var. *novogranatense* typically have fewer but larger intercostal areas and tertiary areoles than do those of either variety of *E. Coca*. Leaves of *E. novogranatense* var. *truxillense* are often intermediate in this respect but may reveal the full range of patterns exhibited collectively among leaves of the other three varieties (Plate 40).

All tertiary areoles are subdivided by a random reticulum of slender, fourth and fifth order veinlets, which constitute a moderately well developed system of small, non-oriented, polygonal and quadrangular areoles. This system of areoles is best developed (i.e. most completely closed) and contains more numerous areoles in both varieties of *E. Coca*, whereas leaves of *E. novogranatense* varieties normally have a more open system of fewer and slightly larger areoles (Plates 39 and 40).

The relative number of freely terminating veinlets in coca leaves serves as a quantification of qualitative differences in high order venation and areolation among the four cultivated varieties. Leaves of *E. Coca* varieties often contain fewer veinlet termini per mm^2 and thus have more numerous ultimate areoles than do those of either variety of *E. novogranatense* (Table 5; Plates 39 and 40). Although leaves of *E. novogranatense* var. *truxillense* have the highest veinlet termination numbers of all coca varieties, they may show a degree of variation equal to that observed collectively among the other three varieties, as is the case with qualitative aspects of their form and venation (Table 5). Veinlet termini are typically tracheoid with spiral or pitted secondary walls (Plate 40). Tracheoid idioblasts were not observed in any variety.

The marginal ultimate venation of all coca leaves consists of

second through fourth order, loop-forming veins which promote its "festooned" appearance due to the nearly complete closure of the intramarginal, loop-forming veinlets.

EPIDERMIS: Epidermal cells typically are polygonal in surface view with straight lateral walls. The cells are larger in the upper epidermis, although their sizes are normally uniform within each surface layer. Epidermal cell walls appear slightly sinuous only rarely in occasional specimens of *E. novogranatense* var. *novogranatense*.

Stomata are of the paracytic type, with their paired subsidiary cells aligned parallel to the long axis of the guard cells, and are restricted to the lower epidermis in all leaves (Plate 37). Statistical data for stomatal density, frequency and guard cell size are summarized in Table 5.

Epidermal papillae are prominent and abundant but confined to the lower surface of the leaves. They are always absent from the guard cells and associated subsidiary cells of the stomatal apparatus.

CRYSTALS: Vein-associated, prismatic (rhomboidal) crystals of calcium oxalate may be abundant, sparse or absent in all coca leaf varieties. Prismatic crystals also may occur in clusters of anticlinally subdivided cells of the lower and upper epidermis in all varieties.

FOLIAR SCLEREIDS: Foliar sclereids are typically absent from all cultivated coca leaves but may be characteristic of other species of *Erythroxylum* (Rury, 1981, 1982).

DISCUSSION

LEAF STRUCTURAL PLASTICITY OF COCA LEAVES

Light intensity, humidity and moisture availability may influence profoundly the relative leaf size, form, vein thickness and patterns, as well as stomatal and veinlet terminus numbers in all varieties of cultivated coca (Rury, 1981, 1982). Classical shade-leaf as opposed to sun-leaf structural differences may be found within each variety in relation to microhabitat differences experienced by individual plants and leaves. Humid and shady

microhabitat conditions result normally in the development of relatively large, thin leaves with reduced numbers of stomata and veinlet termini per unit area, as well as more slender and less conspicuous veins. Conversely, sunny and drier habitats induce the formation of small and thicker leaves with comparatively more numerous stomata and veinlet termini, and more prominent, thicker veins. Shade-leaf morphology appears not only in South American coca plants grown under shaded conditions, but also in plants of each variety cultivated under glass at temperate latitudes in North America (Rury, 1982; Plate 39D, E). Due to this habitat-related plasticity in the structure of coca leaves as well as their intergrading patterns of leaf structural variation among the four varieties, identifications of coca leaves and leaf fragments are often problematic (and ill-advised) in the absence of relevant ecological and geographic data for the specimens under consideration. The taxonomically most useful structural features of cultivated coca leaves are summarized in Table 3.

COMPARISON OF ARCHEOLOGICAL AND RECENT COCA LEAVES

Although superficially similar in form and venation, leaves of the four modern varieties of cultivated coca can be distinguished on the basis of subtle differences in shape and size, central panel prominence, details of low and high order venation, and stomatal features, especially when such data are integrated with ecological and geographic information for the specimens. On similar grounds, it is possible to determine the specific and varietal affinities of archeological coca leaves.

Selected leaf structural features of both archeological and recent coca plants from South America are summarized in Table 5. These statistical data are of taxonomic value, however, only when assessed together with qualitative aspects of leaf structure. The archeological leaves studied here clearly are more similar to recent leaves of the cultivated cocas than to any wild species of *Erythroxylum* (see Tables 3, 4). Although several wild species of *Erythroxylum* of the neotropical section *Archerythroxylum* (*sensu* Schulz, 1907) may resemble cultivated coca varieties in

their leaf structure, the archeological leaves studied here are easily distinguished from any wild "coca mimics" (Rury, 1981, 1982).

Features shared by archeological and recent coca leaves include their: (1) size and form; (2) variable prominence of a central panel on the lower leaf surface; (3) patterns of low and high order venation; (4) comparable numbers of freely terminating veinlets per mm^2 of leaf area; (5) polygonal epidermal cells with straight (anticlinal) walls; (6) epidermal papillae restricted to the lower leaf surface; (7) paracytic stomata of similar dimensions and numbers, also restricted to the lower leaf surface; and (8) numerous prismatic crystals associated with veins and occurring within subdivided epidermal cells.

All archeological coca leaves studied here are morphologically identical to recent leaves of Trujillo coca (*E. novogranatense* var. *truxillense*) in their small size, mostly lanceolate shape, acute leaf apices and cuneate leaf bases, as well as their reduced prominence of a central panel. As in recent Trujillo coca, the archeological leaves reveal a basic foliar venation pattern which is intermediate between the characteristic eucamptodromous configuration of *E. Coca* var. *Coca* and the slender-veined, brochidodromous pattern of most leaves of *E. novogranatense* var. *novogranatense*. Details of leaf venation in the archeological leaves which conform to our typology for Trujillo coca include: (1) the divergence angles and irregular course of the secondary veins; (2) an intermediate number of secondary veins and intercostal areas; (3) a relatively incomplete (open) system of high order venation, with (4) a rather large number of freely terminating veinlets.

Statistical details of *Erythroxylum* leaf structure are both ecologically more variable and taxonomically less reliable than qualitative aspects of foliar form, venation and anatomy. Nevertheless, our archeological leaves fall clearly within the range of statistical variation in stomatal and venation systems observed among leaves of all four modern coca varieties (Table 5). The archeological leaves are more similar in these features to both varieties of *E. novogranatense* than to either variety of *E. Coca*, but most closely resemble leaves of Trujillo coca in their

larger stomata, reduced stomatal frequency and higher number of veinlet termini (Table 5).

Surprisingly, the archeological leaves examined here possess much larger but fewer stomata per unit of leaf surface (i.e., stomatal density) than do modern leaves of the same Trujillo variety. Perhaps the archeological leaves reflect a real difference in the stomatal system of ancient versus recent Trujillo coca, although more samples of both archeological and modern leaves are needed to evaluate this possibility. Alternatively, the combination of large and sparse stomata may merely reflect the inverse relationship between stomatal density and the sizes of both individual leaves and their stomata, as previously noted for diverse, pantropical species of *Erythroxylum* (Rury 1981, 1982). Due to such habitat-related, morphogenetic effects upon mature coca leaf structure (for example, sun- vs. shade-form leaves), the stomatal frequency provides a more reliable basis for comparisons among coca leaves, since it integrates both stomatal size and density into a single, standard measurement.

Although the geographic origin of and ecological conditions experienced by the archeological coca leaves are uncertain, their structural conformity with the anatomical profile of modern, drought-adapted Trujillo coca from the arid Peruvian coast suggests that they were grown in a similarly xeric environment. Significantly, the coca leaf (Trujillo) illustrated by Griffiths (1930) also shows drought-adaptive anatomical details characteristic of modern Trujillo coca, such as sunken stomata sparsely distributed over the lower epidermis, and a small, lanceolate leaf morphology. This further supports the contention (Plowman, in press) that drought-resistent Trujillo coca was being grown at an early date on the desert coast of Peru.

PROBLEMS IN THE ARCHEOLOGY OF COCA

In most cases in the past, archeological coca leaves from the Peruvian coast have been identified by both botanists and archeologists as *Erythroxylum Coca* (var. *Coca*). Harms (1922) was the first botanist to identify the small-leaved coca from coastal Peruvian sites as *E. novogranatense,* since he was familiar with the taxonomic studies on *Erythroxylum* by his

colleague O. E. Schulz (1907). Many authors, however, unaware of the existence of the coastal variety Trujillo coca, have suggested that the presence of archeological coca on the Peruvian coast implied extensive, early trans-Andean trade in coca from the eastern Andes to the coast (Sauer, 1950; Lanning, 1967; Cohen, 1978; Dobkin de Rios, 1981). Although trade in leaves of *E. Coca* var. *Coca* from the eastern Andes to the coast may have occurred on a small scale, there is little evidence for it from archeological remains. Only Mortimer (1901) reported and illustrated leaves of this variety from the coast (from a burial at Arica, Chile) which from the illustrations are clearly referable to *E. Coca* var. *Coca*. This suggests that at least some leaves of this variety may have been traded across the Andes but most likely Trujillo coca was the principal variety used on the coast.

Although samples of archeological coca discovered to date are limited primarily to Trujillo coca from coastal Peru, future discoveries of archeological leaves have great potential for shedding new light on the early evolution, domestication and diffusion of coca in the Andean region and may possibly serve as cultural markers for early human contacts in the area. It is hoped that this study will stimulate archeologists to search for remains in older sites and in new areas in order to elucidate further the early events in the evolution of cultivated coca.

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TABLE 1

ARCHEOLOGICAL COCA SPECIMENS EXAMINED (ALL REFERABLE TO *ERYTHROXYLUM NOVOGRANATENSE* VAR. *TRUXILLENSE*)

Collector	*Description*	*Provenance*	*Approximate Age*	*Museum and Accession Number*
Max Uhle[1]	Coca leaves contained in woollen bag	Peru: Dept. Arequipa. Yauca Valley, Lampilla.	Inca, Late Horizon (1476–1534 A.D.)	Lowie Museum 4-8225
Max Uhle	Coca leaves contained in woollen bag	Peru: Dept. Ica. Ocucaje. Cerro Uhle.	Late Horizon. (1476–1534 A.D.)	Lowie Museum 4-4519
Max Uhle	Coca leaves contained in woollen bag	Peru: Dept. Ica. Chulpaca.	Late intermediate period	Lowie Museum 4-4372
Max Uhle	Coca leaves contained in woven bag	Peru: Dept. Arequipa. Acarí.	"Mochica"	Lowie Museum 4-8268a
Wattis collection	Coca leaves contained in cotton bag	Peru: Dept. Ica. Taruga Valley. Atarco II site, Inca Cemetery.	Late Horizon	Lowie Museum 16-13426
John M. Blake (1836)	Coca leaves from woollen bag.	Chile: Bay of Chacota, 1.5 mi. south of Arica. Inca Cemetery.	Inca Period.	Peabody Museum, Harvard University, 13072

L. M. Stumer (1953–1955)	Fragments of coca leaves and twigs	Peru: Dept. Lima. Rimac Valley. Vista Alegre.	Probably Late Horizon	Botanical Museum, Harvard University, 10-116, 10-117.
L. M. Stumer[1] (1953–1955)	Broken coca leaves and two small endocarps	Peru: Dept. Lima. Rimac Valley. Vista Alegre.	Probably Late Horizon.	Botanical Museum, Harvard University, 10-124.
Unknown, "Nazca no. 1"[1]	Leaf fragments	Peru: Dept. Ica. Nazca region.	"Cultura Nazca"	Museo de Historia Natural 'Javier Prado'. Original material from Museo Regional de Ica.
Unknown, "Nazca no. 4"[1]	Leaf fragments from "bolsa de piel"	Peru: Dept. Ica. Nazca region.	"Cultura Nazca"	Museo de Historia Natural 'Javier Prado'. Original material from Museo Regional de Ica.
Unknown, "Nazca no. 6"[1]	Leaf fragments from "bolsa de la cultura Nazca"	Peru: Dept. Ica. Río Grande valley. Hacienda Monte Grande	"Cultura Nazca"	Museo de Historia Natural 'Javier Prado'. Original material from Museo Regional de Ica.
Unknown, "Nazca no. 8"[1]	Leaf fragments from "bolsa de la cultura Nazca"	Peru: Dept. Ica. Nazca region. Hacienda Cahuachi.	"Cultura Nazca"	Museo de Historia Natural 'Javier Prado'. Original material from Museo Regional de Ica.
J. Parsons	Four coca endocarps	Peru: Dept. Lima Chilca.	Late intermediate period (post 1100 A.D.)	J. Parsons collection.

[1] Material prepared for anatomical study.

TABLE 2

RECENT LEAF SPECIMENS OF CULTIVATED COCA
(*ERYTHROXYLUM* SPP.) EXAMINED

Species & Variety	*Collector & Number* [1]	*Locality (Country & Department)*[2]	*Location of Voucher Herbarium Specimens*[3]
E. Coca Lam. var. *Coca*	Cook & Gilbert 1711*	PERU: Cuzco	US
	Plowman & Kennedy 5793	PERU: Huánuco	ECON, F, K, NCU, US, USM
	T. Plowman 5181*	BOLIVIA: La Paz	COL, ECON, P, US
	T. Plowman 5827*	PERU: Huánuco	ECON, F, K, NCU, US, USM
	T. Plowman 5830	PERU: Huánuco	ECON, F, K, NCU, USM
	T. Plowman 5833	PERU: Huánuco	ECON, F, K, NCU, USM
	T. Plowman 5839	PERU: Huánuco	ECON, F, NCU, USM
	T. Plowman 5862	PERU: Huánuco	ECON, F, NCU, USM
	T. Plowman 5932	PERU: Huánuco	F, GH, NCU, USM
	T. Plowman 5975	PERU: Huánuco	ECON, F, K, NCU, NY, SP, US, USM
	T. Plowman 6042	PERU: San Martín	AAU, ECON, F, K, NCU, US, USM
	T. Plowman 6061*	PERU: Huánuco	ECON, F, NCU, USM, VEN
	Plowman & Schunke 7510*	PERU: San Martín	ECON, F, NCU, P, USM
	Plowman *et al.* 11271	PERU: Huánuco	ECON, F, USM
	Plowman *et al.* 11272	PERU: Huánuco	ECON, F, USM
	P. M. Rury 320	PERU: Cuzco	ECON, USM
	P. M. Rury 321	PERU: Cuzco	ECON, USM
	P. M. Rury 322	PERU: Cuzco	ECON, USM
	P. M. Rury 323	PERU: Cuzco	ECON, USM
	P. M. Rury 324	PERU: Cuzco	ECON, USM

E. Coca var. *Ipadu* Plowman	E. W. Davis 10	COLOMBIA: Vaupés	ECON, GH, K, MO, NCU, P, US
	E. W. Davis 19*	COLOMBIA: Vaupés	ECON, F, K, MO, NY, US
	Plowman *et al.* 6748	PERU: Loreto	ECON, F, K, NCU, USM
	Plowman *et al.* 7136	PERU: Loreto	AAU, ECON, F, INPA, K, LA, NCU, UBC, USM, VEN
	R. Spruce 73*	BRAZIL: Amazonas	K
	J. Torres 167	PERU: Loreto	ECON, F, NCU
E. novogranatense (Morris) Hieron. var. *novogranatense*	O. F. Cook 98*	COLOMBIA: Nariño	US
	E. W. Davis 557*	COLOMBIA: Cesar	ECON, F
	Lehmann 4737*	COLOMBIA: Cauca	F, GH, K, P, US
	T. Plowman 2020*	COLOMBIA: Putumayo	COL, ECON, F, K, S, US
	Plowman & Davis 3684*	COLOMBIA: Cesar	COL, ECON, NCU
	T. Plowman 3734*	COLOMBIA: Antióquia	COL, ECON, F, S, US
	Plowman *et al.* 3768	COLOMBIA: Cauca	ECON
	T. Plowman 4144*	COLOMBIA: Huila	COL, ECON, F, US
	Plowman & Davis 4152*	COLOMBIA: Huila	COL, ECON, F, US
	Plowman & Vaughan 5272*	COLOMBIA: El Valle	COL, ECON, F, K, NCU, US, USM
	T. Plowman 5382*	COLOMBIA: Cauca	COL, ECON, F, USM
	Plowman & Vaughn 5385	COLOMBIA: Cauca	COL, ECON, F, NCU
	T. Plowman 7600 ex 5373	PERU: Lima	COL, ECON, F, K, US
	T. Plowman 7670	VENEZUELA: Caracas	COL, F, NCU, NY, U, US, VEN
	Plowman & Rury 10980	PERU: Lima	COL, ECON, F, K, MO, NY, U, US, USM

TABLE 2 *(continued)*
RECENT LEAF SPECIMENS OF CULTIVATED COCA
(*ERYTHROXYLUM* SPP.) EXAMINED

Species & Variety	*Collector & Number* [1]	*Locality (Country & Department)*[2]	*Location of Voucher Herbarium Specimens*[3]
E. novogranatense var. *truxillense* (Rusby) Plowman	J. D. Boeke 854*	COLOMBIA: Nariño	F
	R. Ferreyra s.n.* (ECON 34259)	PERU: La Libertad	ECON, USM
	R. Ferreyra s.n.* (ECON 34275)	PERU: La Libertad	ECON, USM
	E. Machado 1256*	PERU: San Martín	MOL, NCSC, US
	Madison *et al.* 4447*	ECUADOR: Carchi	F, NCU, SEL
	Madison *et al.* 4920*	ECUADOR: Carchi	F, NCU, SEL
	T. Plowman 5565	PERU: Amazonas	ECON, F, NCU, RB, USM
	T. Plowman 5583*	PERU: Amazonas	ECON, F, K, NCU, US, USM
	T. Plowman 5588	PERU: Amazonas	ECON, F, NCU, USM
	T. Plowman 5600*	PERU: La Libertad	ECON, F, USM
	T. Plowman 5605	PERU: La Libertad	ECON, F, NCU, USM
	T. Plowman 5606*	PERU: La Libertad	B, ECON, F, NCU, USM, VT
	T. Plowman 5612	PERU: La Libertad	ECON, F, K, NCU, USM
	T. Plowman 5618*	PERU: La Libertad	ECON, F, USM
	T. Plowman 6228 ex 5590	USA: Cult. ex PERU: Amazonas	ECON, F, NCU

T. Plowman 6242 ex 5583	USA: Cult. ex PERU: Amazonas	NCU
P. M. Rury 300	PERU: Cajamarca	ECON, USM
P. M. Rury 301	PERU: Cajamarca	ECON, USM
P. M. Rury 302	PERU: La Libertad	ECON, USM
P. M. Rury 303	PERU: La Libertad	ECON, USM
P. M. Rury 304	PERU: La Libertad	ECON, USM
P. M. Rury 305	PERU: La Libertad	ECON, USM
P. M. Rury 306	PERU: La Libertad	ECON, USM
H. H. Rusby s.n. (NYBG Economic Museum #5463)	Commercial sample from Parke Davis & Co., from Rusby's Materia Medica collection	ECON, F

[1]Anatomical data presented in Table 4 derived from collections marked with an asterisk (*).
[2]Localities described as country and department (state) of origin.
[3]Location of herbarium voucher specimens-herbarium designations follow Index Herbariorum ed. 7, (Holmgren, Keuken & Schofield, 1981).

TABLE 3

TAXONOMICALLY USEFUL LEAF STRUCTURAL FEATURES OF THE CULTIVATED COCAS (*ERYTHROXYLUM* SPP. & VARS.)

CHARACTER	UTILITY
Prominence of central panel*	Typologically useful; most variable among leaves of Trujillo coca.
Leaf venation patterns	Typologically useful (see Table 4)
Adaxial crest above midvein*	Limited value typologically.
Presence and nature of midvein fibrous sheathing (pericycle)	Typologically useful; most variable in Trujillo coca.
Veinlet termination numbers*	Ecologically and biometrically variable within each variety.
Guard cell length*	Ecologically and biometrically variable within each variety
Stomatal density and frequency*	Ecologically and biometrically variable within each variety
Leaf thickness*	Ecologically and biometrically variable within each variety

*Indicates characters which are most reliable when used with other morphological, ecological and geographic data.

TABLE 4

LEAF VENATION PATTERNS OF THE CULTIVATED COCAS
(*ERYTHROXYLUM* SPP.)

	E. Coca Lam. (including var. *Coca* & var. *Ipadu* Plowman	*E. novogranatense* var. *truxillense* (Rusby) Plowman	*E. novogranatense* var. *novogranotense*
BASIC PATTERN	Intergrading series of patterns occur both within and between these varieties: festooned eucamptodromous *to* transitional (intermediate) *to* festooned brochidodromous.		
SECONDARY VEINS	Many (15–40), closely spaced and moderately thick veins; diverging from the midvein at wide acute or 90 degree angles; following a regular, initially straight and exmedially upcurving course.	Generally similar to those of *E. Coca,* but exhibiting the full range of variation between typical leaves of *E. Coca* and *E. novogranatense* var. *novogranatense.*	Fewer (8–18), more widely spaced, slender veins than *E. Coca;* diverging at narrow to wide acute angles; following a less regular, exmedially upcurving course than in typical leaves of *E. Coca.*
INTERCOSTAL AREAS	Relatively numerous and regular in size and shape.	Relatively numerous and regular in size and shape as in *E. Coca* or intermediate between typical leaves of *E. Coca* and *E. novogranatense* var. *novogranatense.*	Fewer, larger and less regular in shape than in typical specimens of *E. Coca* and *E. novogranatense* var. *truxillense.*

TABLE 4 *(continued)*

LEAF VENATION PATTERNS OF THE CULTIVATED COCAS

(*ERYTHROXYLUM* SPP.)

INTERSECONDARY VEINS	Composite in origin from tertiary veins; similar to secondary veins in divergence and course.	Generally very similar to *E. Coca* or intermediate between those of *E. Coca* and *E. novogranatense* var. *novogranatense*.	Similar to, but usually more numerous per intercostal area than, those of *E. Coca*.
TERTIARY VENATION	Diverge from secondary veins at variable angles and form many small, non-oriented areoles of irregular size and shape.	Form many non-oriented areoles that are of a size intermediate between those of *E. Coca* and *E. novogranatense* var. *novogranatense*.	Similar to, but usually fewer and larger tertiary areoles than, those in *E. Coca* and *E. novogranatense* var. *truxillense*.
HIGH ORDER VENATION	Well developed, random or nearly orthogonal network of veinlets.	Most similar to *E. Coca*, but with full range of expression between the two species.	Generally an incomplete, random network with more veinlet termini than *E. Coca*.

TABLE 5

SELECTED ANATOMICAL FEATURES OF ARCHEOLOGICAL AND MODERN COCA LEAVES (*ERYTHROXYLUM* SPP.)

Species and Variety	*Epidermal Papillae*	*Leaf Thickness*	*Veinlet Termini*	*Stomatal Density*	*Stomatal Length*	*Stomatal Frequency*
E. Coca var. *Coca*	+	270 μm (166–576)	20.5 mm^{-2} (16–25)	389 mm^{-2} (341–448)	20.7 μm (20–22)	16.3% (15–18)
E. Coca var. *Ipadu*	+	281 μm (138–424)	20 mm^{-2} (–20–)	444 mm^{-2} (–444–)	20 μm (–20–)	16% (–18–)
E. novogranatense var. *novogranatense*	+	358 μm (212–505)	22 mm^{-2} (–22–)	247 mm^{-2} (–247–)	20 μm (–20–)	8% (–8–)
E. novogranatense var. *truxillense*						
Recent	+	295 μm (193–455)	36 mm^{-2} (25–52)	404 mm^{-2} (379–455)	21 μm (18–25)	18% (13–25)
Archeological	+/–	–	22 mm^{-2} (16–30)	183 mm^{-2} (156–203)	25 μm (–25–)	11.4% (10–13)

NOTE: Overall means given; range of specimen means shown in parentheses.
Data are derived from specimens marked with an asterisk (*) in Tables 1 and 2

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PLATE 32

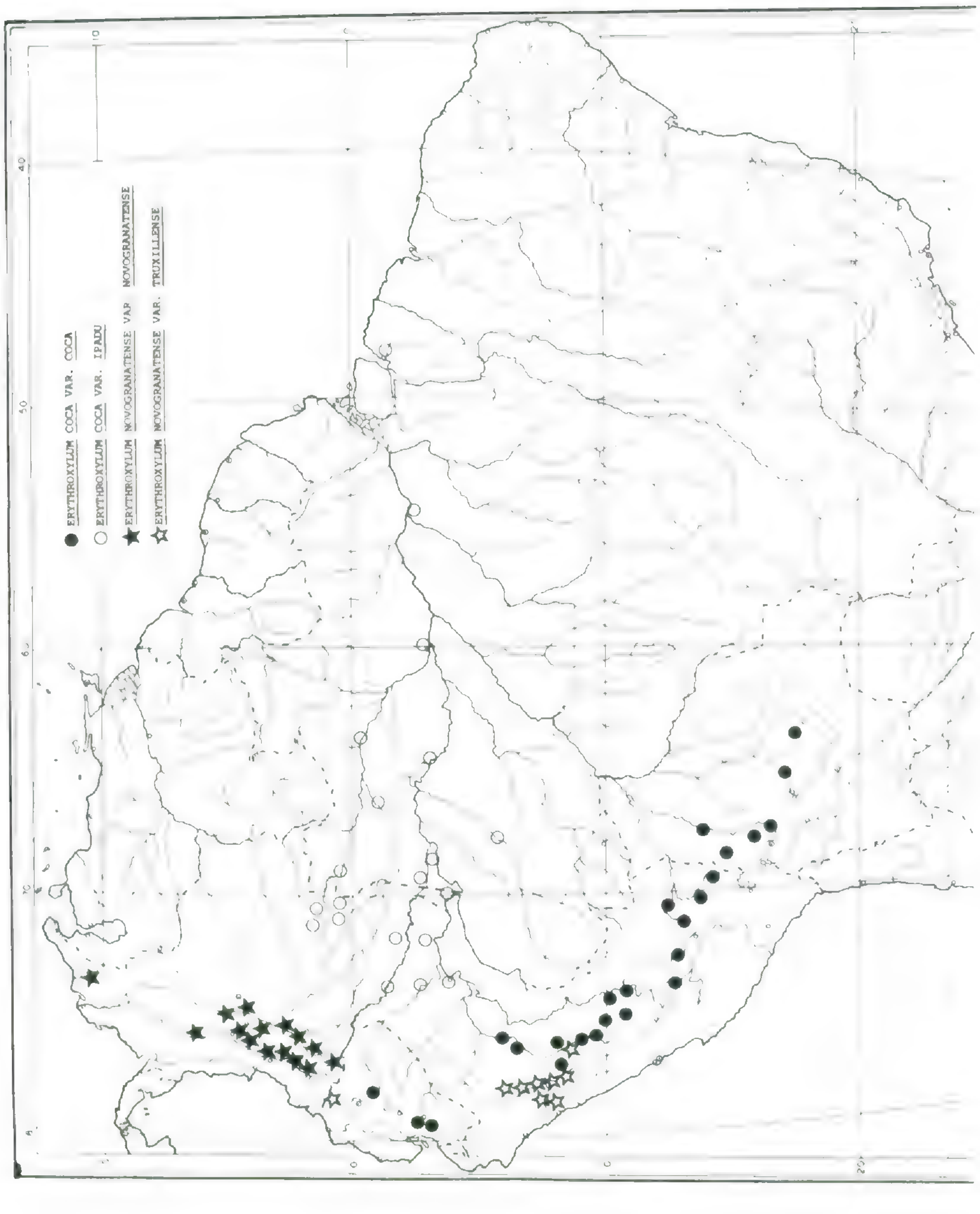

ERYTHROXYLUM COCA VAR. COCA
ERYTHROXYLUM COCA VAR. IPADU
ERYTHROXYLUM NOVOGRANATENSE VAR NOVOGRANATENSE
ERYTHROXYLUM NOVOGRANATENSE VAR. TRUXILLENSE
10
40
50
60
70
80
20

Plate 32. Present distribution of the four varieties of cultivated coca based on herbarium collections: closed circles, *E. Coca* var. *Coca;* open circles, *E. Coca* var. *Ipadu;* closed stars, *E. novogranatense* var. *novogranatense;* open stars, *E. novogranatense* var. *truxillense.*

PLATE 33

Plate 33. Cotton bag containing leaves of Trujillo coca (*E. novogranatense* var. *truxillense).* From an Inca cemetery, Atarco II Site, Taruga Valley, Nazca, Peru. Wattis Collection. Lowie Museum of Anthropology accession no. 16-13426. Photograph courtesy of the Lowie Museum of Anthropology. Centimeter scale.

Plate 34. Leaves of Trujillo coca (*E. novogranatense* var. *truxillense*) from a cotton bag found in an Inca cemetery, Atarco II Site, Taruga Valley, Nazca, Peru. Wattis Collection. Lowie Museum of Anthropology accession no. 16-13426. Upper panel showing adaxial surface of leaves; lower panel showing abaxial surface. Photograph courtesy of the Lowie Museum of Anthropology. Millimeter scale.

PLATE 35

Plate 35. Red tapestry woollen pouch containing leaves of Trujillo coca (*E. novogranatense* var. *truxillense*). Late Horizon (Inca). Collected by Max Uhle. Lampilla, Yauca Valley, Dept. Arequipa, Peru. Lowie Museum of Anthropology accession no. 4-8225. Photograph courtesy of Lowie Museum of Anthropology. Centimeter scale.

PLATE 36

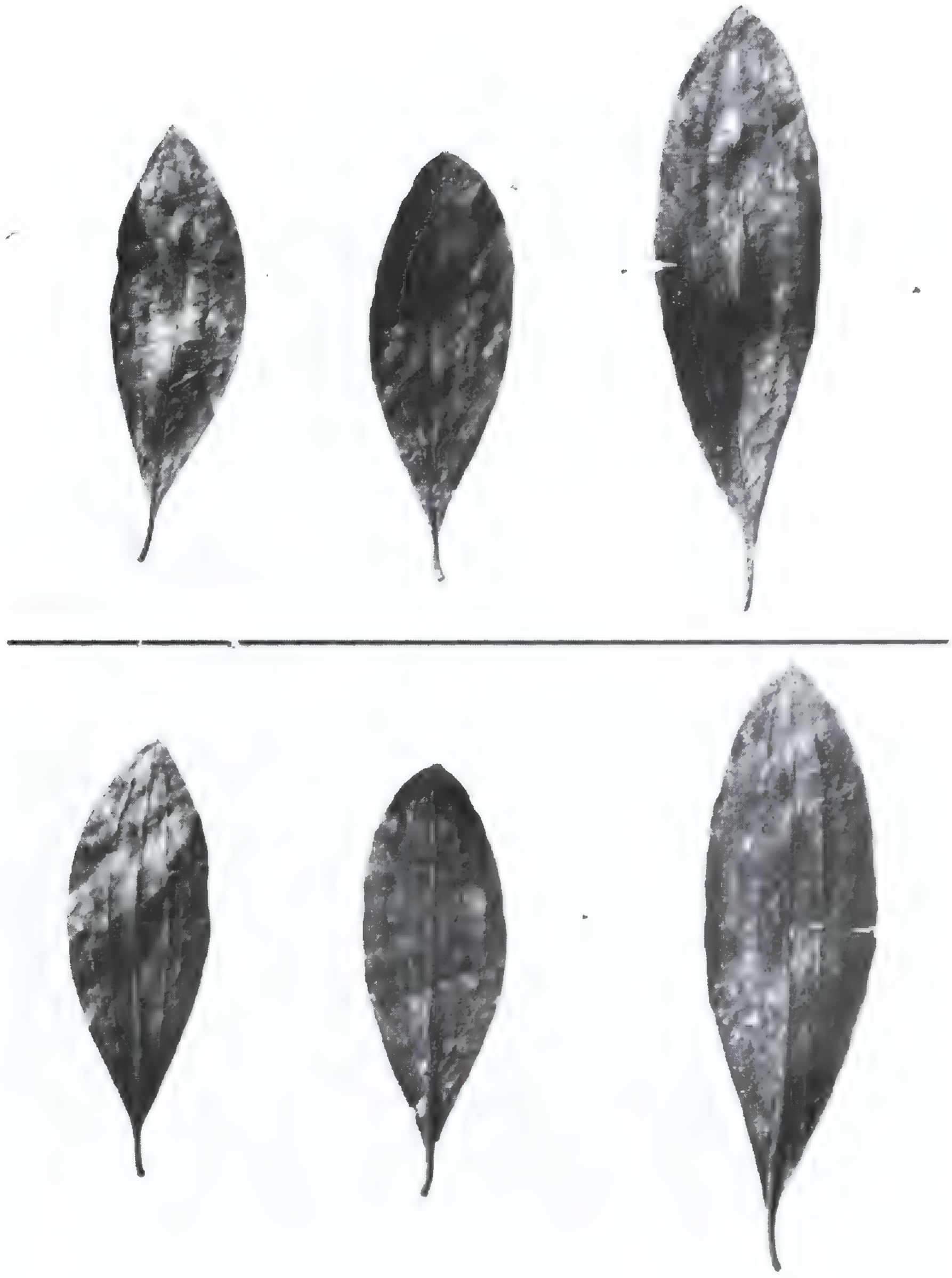


Plate 36. Leaves of Trujillo coca (*E. novogranatense* var. *truxillense*) from a woollen pouch. Late Horizon (Inca). Collected by Max Uhle. Lampilla, Yauca Valley, Dept. Arequipa, Peru. Lowie Museum of Anthropology accession no. 4-8225. Upper panel showing adaxial surface of leaves; lower panel showing abaxial surface. Photograph courtesy of the Lowie Museum of Anthropology. Millimeter scale.

Plate 37. Archeological and recent leaves of Trujillo coca (*E. novogranatense* var. *truxillense*). **A.** Camera lucida drawing of cleared leaf of Lowie Museum of Anthropology accession no. 4-8225 (see Plate 35). Centimeter scale. **B.** Camera lucida drawing of cleared leaf of *Plowman 6228 ex 5590.* Centimeter scale. **C.** Camera lucida drawing of cleared leaf of Harvard Botanical Museum Ethnobotanical accession no. 10–124. Centimeter scale. **D.** Camera lucida drawing of upper epidermis of cleared leaf, specimen "Nazca no. 4". Scale = 50 μm (micrometers). **E.** Camera lucida drawing of lower epidermis of cleared leaf, specimen "Nazca no. 8" Scale = 50 μm (micrometers). **F.** Camera lucida drawing of lower epidermis of cleared leaf showing papillae and stomata, specimen "Nazca no. 1". Scale = 50 μm (micrometers). **G.** Camera lucida drawing of lower epidermis, showing papillae and stomata, *Plowman 6228 ex 5590.* Scale = 50 μm (micrometers).

PLATE 37

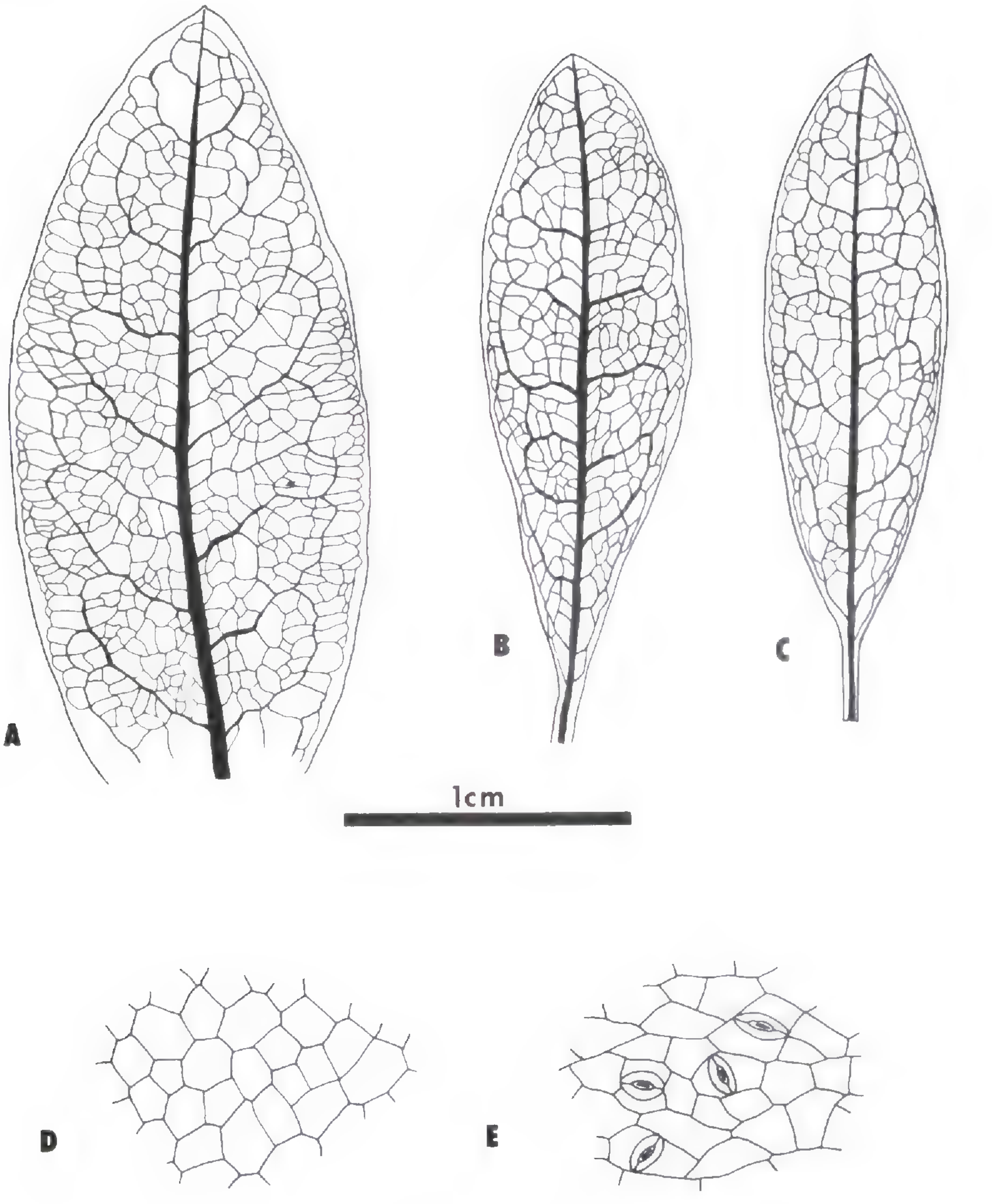


Plate 38. Archeological leaf specimens of Trujillo coca (*E. novogranatense* var. *truxillense*). Photomicrographs of cleared leaves, taken with partially polarized light. Crystals and lignified tissues (veins) appear bright white due to their positive birefringence in polarized light. Scale markers all = 100 μm (micrometers). **A.** Midvein, secondary and high order venation; note numerous crystals which appear as white flecks along veins and in mesophyll. Specimen "Nazca no. 8". **B.** Midvein with secondary vein, tertiary vein and high order venation; note numerous crystals as in Plate 38A, but mostly in mesophyll. Cleared leaf specimen, Harvard Botanical Museum accession no. 10–124. **C.** Midvein and diverging secondary vein with many crystals. Cleared leaf specimen "Nazca no. 4". **D.** Close-up of veinlet of "Nazca no. 4, shown at lower magnification in Plate 38C, revealing crystals along veinlet.

PLATE 38

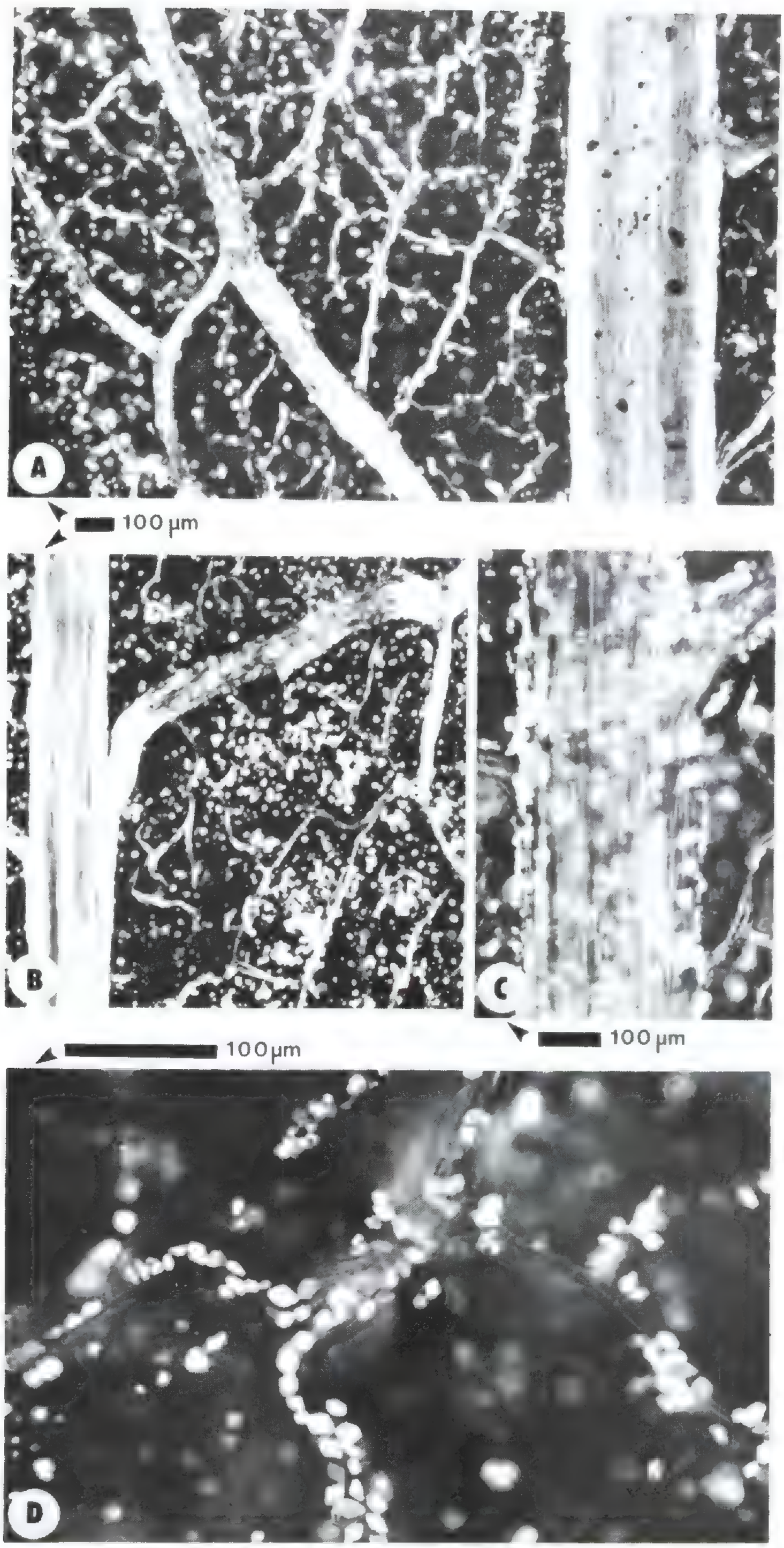


Plate 39. Leaf venation and geographic distribution of the cultivated cocas (*Erythroxylum* spp.). Centimeter scale. This map is the same as that presented in Plate 32. **A.** *E. novogranatense* var. *truxillense* (Trujillo coca), *Madison et al. 4447.* **B.** *E. novogranatense* var. *truxillense* (Trujillo coca), *Madison et al. 4920.* **C.** *E. novogranatense* var. *novogranatense* (Colombian coca), *Plowman 3734.* **D.** *E. novogranatense* var. *truxillense* (Trujillo coca), *Plowman 6242 ex 5583,* glasshouse cultivated progeny (seed) of specimen illustrated in Plate 39E. Note much larger, shade-leaf form of this glasshouse plant as compared with its parent in 39E. **E.** *E. novogranatense* var. *truxillense* (Trujillo coca), *Plowman 5583.* Typical sun-form leaf of parent of glasshouse plant shown above in Plate 39D. **F.** *E. novogranatense* var. *novogranatense* (Colombian coca), *Plowman and Davis 4152.* **G.** *E. novogranatense* var. *truxillense* (Trujillo coca), *Plowman 5600.* **H.** *E. novogranatense* var. *truxillense* (Trujillo coca), *Plowman 5618.* Note the size differences between this and *Plowman 5600* (Plate 39G), from the same locality. **I.** *E. novogranatense* var. *novogranatense* (Colombian coca), *Plowman 7600 ex 5373,* planted from seed by Plowman in Lima in 1976. **J.** *E. Coca* var. *Coca* (Bolivian coca), *Plowman 5827,* local name "molle coca". **K.** *E. Coca* var. *Coca* (Bolivian coca), *Plowman 7510.* **L.** *E. Coca* var. *Ipadu* (Amazonian coca), *Spruce 73.*

PLATE 39

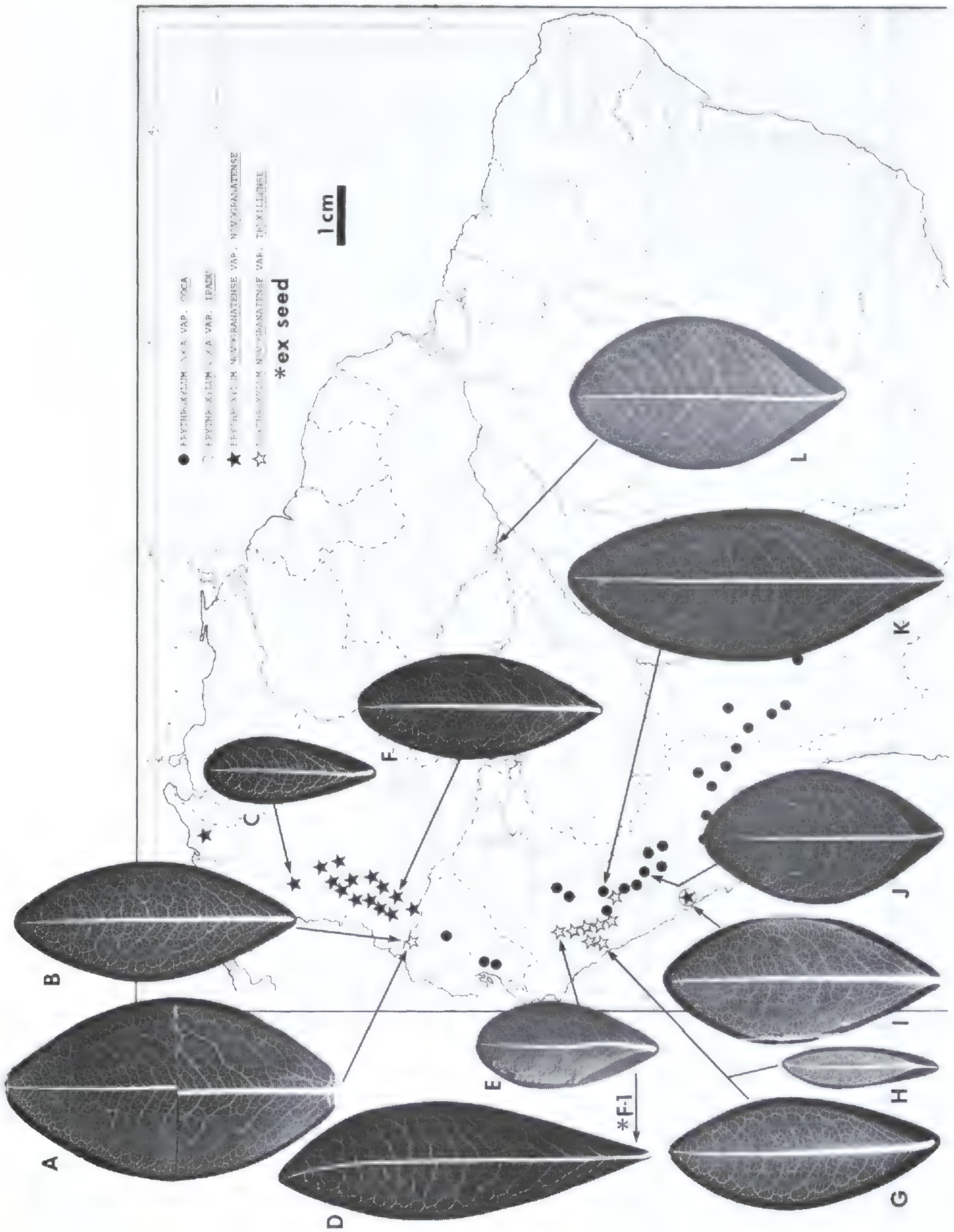
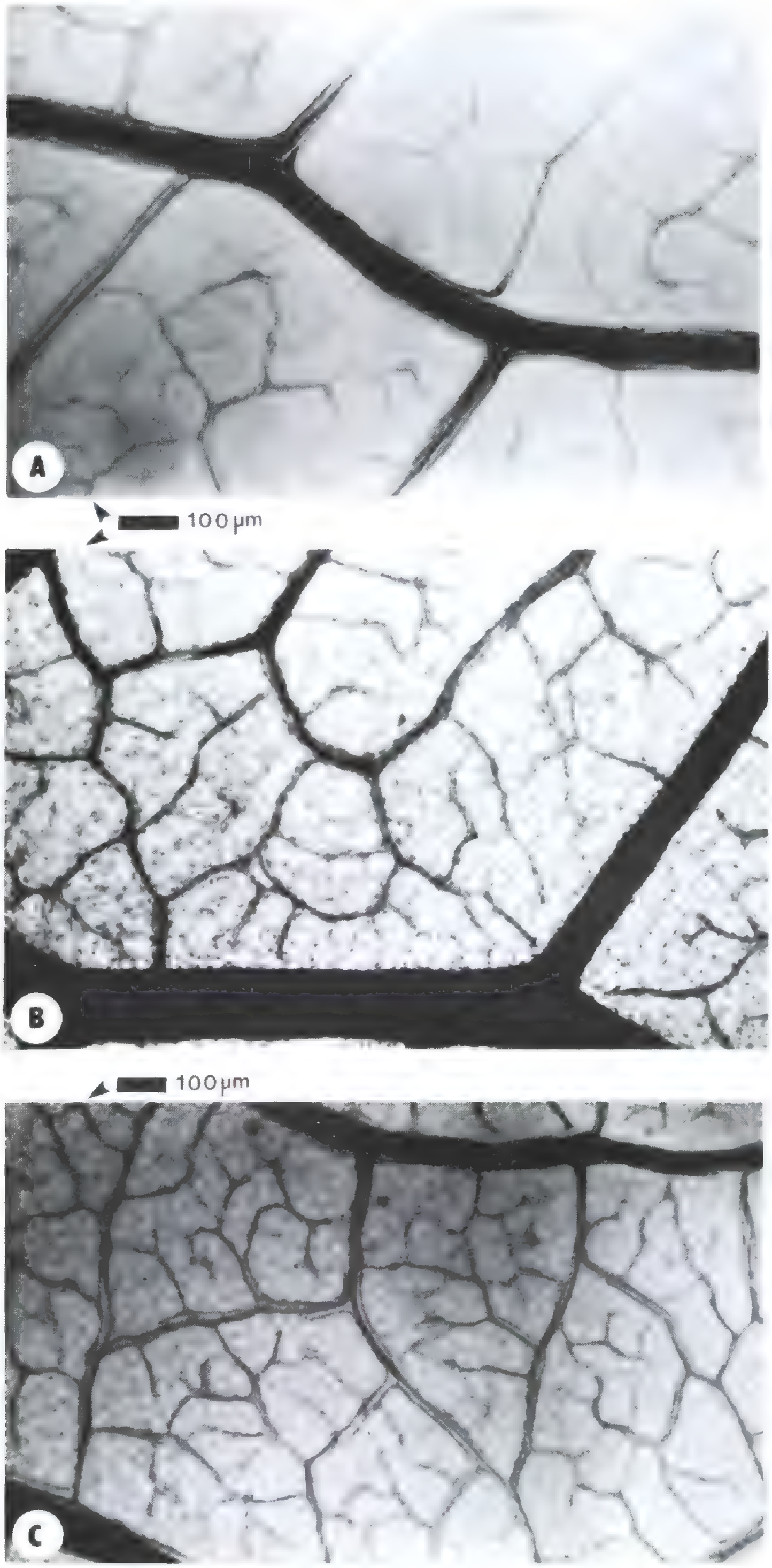


Plate 40. High order venation of recent, cleared leaves of the cultivated cocas (*Erythroyxlum* spp.). Photomicrographs taken without polarized light. Scale markers = 100 μm (micrometers). **A.** *E. novogranatense* var. *novogranatense* (Colombian coca), *Plowman and Davis 3684.* **B.** *E. novogranatense* var. *truxillense* (Trujillo coca), *Boeke 854.* **C.** *E. novogranatense* var. *truxillense* (Trujillo coca), *Plowman 5606.*

PLATE 40



BOTANICAL MUSEUM LEAFLET
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VOL. 29, NO. 4

DE PLANTIS TOXICARIIS E MUNDO NOVO TROPICALES COMMENTATIONES XXXIII

ETHNOBOTANICAL, FLORISTIC AND NOMENCLATURAL NOTES ON PLANTS OF THE NORTHWEST AMAZON

RICHARD EVANS SCHULTES

There is little doubt that the northwestern part of the Amazon Valley—especially that part lying within the boundaries of the Republic of Colombia—has a flora made up of more species than perhaps any other equal extension of the tropical world. It has been estimated that some 80,000 to 85,000 species of higher plants comprise its flora.

The greater part of this vast assemblage of plant species has never been subjected to chemical study. In fact, there exist entire families endemic to this region of which we know nothing concerning the chemical constitution of the species. One method of focusing the attention of phytochemists and pharmacologists on this wealth of species is to explore the ethnobotanical knowledge which native peoples over the millenia have amassed by trial and error about the properties of plants in their ambient vegetation.

During the course of many years of field work in the Colombian Amazon, I have been able to collect specimens of many medicinally esteemed species, to record a large number of plant names in the rapidly disappearing native languages and to collect several species or genera wholly unknown in the Colombian Amazon.

This paper, then, offers a miscellany of notes, based primarily on field work, concerning native uses of plants and floristic and nomenclatural information on the flora of the Amazonia, primarily that part included in the Republic of Colombia.

The families are arranged in accord with the Engler-Prantl system of classification. The genera are listed alphabetically under the families.

Most of the collections cited are preserved in the Gray Herbarium and/or in the Economic Herbarium of Oakes Ames, both at Harvard, and in the Herbario Nacional de Colombia in Bogotá.

TRICHOLOMATACEAE

Marasmius Schultesii *Singer* in Fl. Neotrop. 17 (1976) 131.

COLOMBIA: Comisaría del Amazonas-Vaupés, Río Apaporis, Soratama (between Ríos Pacoa and Kananarí). July 3, 1951. *Schultes et Cabrera 12869.*

This tiny mushroom, growing saprophytically on roots in upland forest above the flood level, is the only fungus that I ever collected in the northwest Amazon for its presumed medicinal use. It is not common, but where it occurs it seems to grow in relatively large patches. The Taiwano Indians of the region gather several handfuls and, after drying it in the sun, reduce it to a powder which is put into the ear to treat cases of fungal infection of the ear-drum. The powder is applied in the evening and must be washed out each morning. Several days of the treatment, according to the only Indian from whom this use was ascertained, are said to be sufficient to relieve this frequent ailment and to restore normal hearing and balance.

The Taiwano name for mushrooms in general is *e-kee'*. This species is known as *ta-te-e-kee'*.

PALMAE

Mauritiella sp.

COLOMBIA: Comisaría del Amazonas, Río Apaporis, Soratoma. "In clumps, 5–10 together. Stems devoid of spines. Fruit ripens brown, smaller than usual species." June 21, 1951. *Schultes et Cabrera 12792.*

The fruits of this palm provide an oil which the local Indians employ to treat fungal infections of the skin. The oil is frequently utilized as a vehicle of other drug plants.

The Kuripako name is *ka-da-na-ree-pe*; in Puinave, the plant is known as *kee*.

There are indications that other species of *Mauritiella* may be similarly used.

MENISPERMACEAE

Curarea toxifera *(Wedd.) Barneby et Krukoff* in Mem. N.Y. Bot. Jard. 22, pt. 2 (1971) 9.

COLOMBIA: Comisaría del Putumayo, Río Sucumbios. April 2–5, 1942. *Schultes 3522.*—Río Guaumués, Salvador. August–September 1963. *Naranjo et Wiederhold 16.*—Río Putumayo, Remanso. October 22, 1966. *Pinkley 392.*

Comisaría del Vaupés, Río Macaya, Cachivera del Diablo. "Vine. Fruit yellow, bitter." May 1943. *Schultes 5526.*—Río Makú-paraná. June 1 8, 1970. *Silverwood-Cope* 23.

Comisaría del Amazonas, Río Loretoyacu. "Woody vine." January 3, 1973. *Glenboski C-197.*—Río Amacayacu. No date. *Díaz M. 10.*—Lago de Tarapoto, Puerto Nariño. No date. *Díaz M. 36.*

ECUADOR: Provincia del Napo, Río Aguarico, Dureno. June 18, 1966. *Pinkley 285.*

PERU: Departamento del Loreto, Iquitos region, Pucuruyacu. August 4, 1966. *Martin et Lau-Cam 1204.*—Río Napo, Negro Urio. August 6, 1966. *Martin et Lau-Cam 1266.*—Same locality. August 16, 1966. *Martin et Lau-Cam 1273.*—Río Napo, Nunies Cocha. March 7, 1968. *Tina et Tello 2066.*

This vine is used in the preparation of curare over a very wide area in the western Amazon.

In the Iquitos region, it is employed to make "poison for hunting small birds and animals." The Kofán Indians of Ecuador and Colombia, who call the vine *sa-pe'-pa* and *ko-yu-vi-u-fa-se-he'-pa,* crush the wood of the stem for elaborating one of their types of curare. It was formerly employed by the Karijonas of the upper Vaupés for the same purpose. The Witotos of Colombia and Peru valued it, calling the plant *isaveño* and *taufe-yeida.* Amongst the nomadic Bara-makú Indians of the Vaupés, who prepare from it a strong arrow poison much prized by neighbouring tribes, scrape the bark from the root for use; they call the plant *awa-puch* which means "monkey root."

According to Glenboski, the Tikunas of the Río Loretoyacu soak the bark in water to bathe wounds. It is locally called *bejuco bravo.*

In Peru and Colombia, the vine is known as *abuta, abuta amarilla* and *abuta hembra.*

MYRISTICACEAE

Compsoneura Sprucei *(A.DC.) Warburg* in Nova Acta Acad. Leop-Carol. 68 (1897) 143.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. "Bush. Flowers white." September 27-October 20, 1966. *Schultes, Raffauf et Soejarto 24191.*

With a Dragendorff reagent, a spot test for alkaloids, this bush was negative.

Iryanthera juruensis *Warburg* in Verh. Bot. Ver. Prov. Brand. 17 (1905) 137.

COLOMBIA: Comisaría del Amazonas, Leticia and vicinity. "Tree 50 feet. Fruit green." August–September, 1966. *Schultes, Raffauf et Soejarto 24105.*

This tree gave a negative test for alkaloids with a Dragendorff reagent spot test.

Iryanthera Tessmannii *Markgraf* in Notizbl. Bot. Gart. Berlin 10 (1928) 236.

PERU: Departamento de Loreto, region of Iquitos. Uchpacano. Alt. 120 m. "Blackish clay soil, lowland. Tree 25 m. tall, 30 cm. diameter. *Cumala roja.* January 30, 1968. *Tina et Tello 2048.*

According to the collectors, the bark (no other part of the plant) is used in treating diarrhoeas. The decoction is prepared as follows: "Crush up 25 grams of fresh bark of *cumala roja* and mix with a big cup of water; then filter it and drink all the liquid you get (must be a big cup) twice a day, during two days. Repeat it [if] diarrhoea continues."

Iryanthera tricornis *Ducke* in Trop. Woods, no. 31 (1932) 11.

BRAZIL: Estado do Amazonas, Rio Purús, vicinity of Jamandí Indian village, Río Apitua, tributary of Río Purús. "Forest on terra firme. Tree 12 m. × 15 cm. diameter. Flowers green." July 1, 1971. *Prance, Maas et al. 13938.*

PERU: Departamento de Loreto, Río Nanay, Picuruyacu. January 15, 1968. *Tina et Tello 2039.*

The local vernacular name for this species in Peru is reported to be *pucuna caspi.*

Iryanthera Ulei *Warburg* in Verh. Bot. Ver. Prov. Brand. 47 (1905) 137.

COLOMBIA: Comisaría del Amazonas, Río Apaporis, Soratama. "Large tree." September 28, 1951. *Schultes et Cabrera 14168.*

PERU: Departamento de Loreto, region of Iquitos, Río Itaya, San Antonio. "Tree, petals white, pistil light yellow-green. Resin reddish." July 30, 1966. *Martin et Lau-Cam 1185.*

"The Taiwano Indians of Colombia grind the bark and mix it with clay for the manufacture of pots."

The resin of this tree, locally called *cumala colorada*, is "put on cotton and applied to the roof off the mouth for *patco,* a disease where a white substance appears in a child's mouth."

Osteophloeum platyspermum *(A.DC.) Warburg* in Nova Acta Acad. Leop.-Carol. 68 (1897) 162.

BRAZIL: Estado do Amazonas, basin of Rio Negro, Rio Uneiuxí, Makú Indian village, 300 km. above mouth. "Forest on terra firme. Tree 25 m. × 40 cm. diameter. Flowers green." October 23, 1971. *Prance, Maas et al. 15571.*

Estado do Amazonas, vicinity of Manáos, Rio Negro, Reserva Ducke. "Tree 90 feet." April 11–14, 1972. *Schultes et Rodrigues 26126a.*

According to the collectors, the Makú Indians who call this tree *tugnebãnpe,* drink the sap as a cure for coughs and colds. In the vicinity of Manáos, woodcutters burn the leaves and inhale the smoke to relieve asthma.

LEGUMINOSAE

Adipera bicapsularis *(L.) Britton et Rose,* Sci. Survey Puerto Rico & Virgin Isl. 5 (1924) 370.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. "Large bush. Flowers yellow." March 1946. *Schultes 7170.*

The inhabitants in the Leticia area call this shrubby treelet *hoja de la pioja* ("flea-leaf"). The dried leaves are pulverized, and the powder is used as a repellant of lice: it is dusted in hammocks and in clothing.

Calliandra angustifolia *Spruce ex Bentham* in Trans. Linn. Soc. 30 (1875) 539.

COLOMBIA: Comisaría del Putumayo, Remanso. August 22, 1966. *Pinkley 395A.*

ECUADOR: Río Aguarico, Dureno. December 27, 1965. *Pinkley 30.*

Calliandra angustifolia is cultivated purely as an ornamental by the Kofáns who, according to the collector, call the plant *sinsin-ño'* and *poi-fa-ko'*.

Calliandra vaupesiana *Cowan* in Bot. Mus. Leafl., Harvard Univ. 18 (1958) 142, t.xxix, d–f.

COLOMBIA: Comisaría del Vaupés, Río Kubiyú, Sabana con arenisca de Guaranjudá. Alt. c. 350–400 m. June 30, 1958. *García-Barriga, Schultes et Blohm 16045.*

This collection represents the fifth, all from the quartzitic savannahs of the Colombian Vaupés. The species appears to be an endemic with no close relatives.

Cassia spinescens *Hoffmannsegg ex Vogel.* Syn. Cass. (1837) 27.

COLOMBIA: Comisaría del Putumayo, Río Sucumbios, Conejo and vicinity. April 2–5, 1942. *Schultes 3649.*

Amongst the Kofán Indians, the powdered leaves are considered to be an excellent repellant of body lice.

Chamaesenna reticulata (*Willd.*) *Pittier* in Trab. Mus. Com. Venez. 3 (1928) 160.

COLOMBIA: Comisaría del Amazonas, Río Karaparaná, El Encanto. May 22–28, 1942. *Schultes 3807.*

Comisaría del Vaupés, Río Vaupés, Mitú. March 8, 1944. *Gutiérrez et Schultes 950.*—Same locality. *Schultes et Cabrera 13971.*

The Tukano Indians of the Río Vaupés call this bush *o-ree'*. It is cultivated for its use as an insect repellant. The powdered leaves are spread in hammocks and clothing.

Among the Witotos of the Río Karaparaná, the root has febrifugal properties when prepared in a tea with the root of a species of *Chelonanthus.*

Elizabetha princeps *Schomburgk ex Bentham* in Hooker, Journ. Bot. 2 (1840) 92.

BRAZIL: Estado do Amazonas, Rio Cauaburí, Maturacá. July 5–August 12, 1967. *Schultes 24578.*

The bark of this beautiful 40-foot tree, which the Waika Indians call *a-ma'*, is burned for ashes to mix with epena-snuff prepared from the red "resin" of *Virola theiodora* (Spr. ex Benth.) Warburg (Schultes et Holmstedt: Rhodora 70 (1968) 113–160.

The bark and petioles are alkaloid-negative with a Dragendorff reagent spot test.

Eperua leucantha *Bentham* in Martius, Fl. Bras. 15, pt. 2 (1870) 225.

COLOMBIA: Comisaría del Vaupés, Río Kuduyarí. October 16, 1952. *Schultes et Cabrera 17872.*

In the Vaupés, this tree is known as *copaiba-rana, yauacano* or *yebaro*. The beautiful rose-purple flowers are sometimes made into a tea for bathing the hair in the belief that it "strengthens the growth of the hair."

The bark is prepared in the form of a strong tea taken to cause vomiting. The Puinaves call this small, white-flowered tree *tö-ee*; the Kubeo, *o-kö'-gee.*

Eperua oleifera *Ducke* var. **campestris** *Ducke* in Bull. Mus. Hist. Nat. Paris, ser. 2, 4 (1932) 728.

BRAZIL: Estado do Amazonas, Rio Negro, Manáos. September 1948. *Schultes et López 10337.*

In the region of Manáos, a brownish oil extracted from the bark is valued in sealing cracks or splits in dugout canoes. The oil is very aromatic but has a rather disagreeable odour; it is employed medicinally in rubbing on painful or rheumatic joints. The local name is *copaiba-rana.*

Eperua purpurea *Bentham* in Martius, Fl. Bras. 15, pt. 2 (1870) 226.

COLOMBIA: Comisaría del Vaupés, Río Guainía, Caño del Caribe. "Enormous tree. Flowers purple. Local name: *yebero.*" November 2, 1952. *Schultes, Baker et Cabrera 18268.*—Río Negro, San Felipe and vicinity, October 24, 1952. *Schultes, Baker et Cabrera 17955.*—Río Vaupés, between Mitú and Javareté. Cerro de Tipiaca. "Columnar tree. Diameter 18 inches. Height 75 feet. At base of mountain." May 14–15, 1953. *Schultes et Cabrera 19324.*

The Desano name for *Eperua purpurea* is *boo-roo-gö'*; the Guanano, *boo-too-ke'*. These Indians use it in the same way as *Eperua leucantha:* to encourage thick growth of the hair.

Peltogyne catingae *Ducke* in Trop. Woods. no. 31 (1932) 13.

COLOMBIA: Comisaría del Vaupés, Río Negro, Piedra del Cocuí. "Bushy tree, 20 feet tall." December 27, 1947. *Schultes et López 9517.*

This rare species is new to the flora of Colombia.

Peltogyne parvifolia *Spruce ex Bentham* in Martius, Fl. Bras. 15, pt. 2 (1870) 233.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Soratama. "Enormous tree." January 1952. *Schultes et Cabrera 19853.*

This species can now be reported for the flora of Colombia.

Tachigalia cavipes (*Spr. ex Benth.*) *Macbride* in Publ. Field Mus. Nat. Hist. Bot. Ser. 13, pt. 3 (1943) 127.

COLOMBIA: Comisaría del Amazonas, Río Miritiparaná, Caño Guacayá. May 8, 1952. *Schultes et Cabrera 16463.*

Comisaría del Vaupés, Río Vaupés, Mitú, November 12, 1939. *Pérez-Arbeláez et Cuatrecasas* 6738.—Río Apaporis, Raudal Jerijerimo. July 8, 1951. *Schultes et Cabrera 12981.*—Same locality. August 22, 1952. *Schultes et Cabrera 16997.*—Río Kananarí, Cerro Isibukuri, September 29, 1951. *Schultes et Cabrera 14690.*—Same locality. November 29-30, 1951. *García-Barriga 13779.*—Río Piraparaná, middle course. *Schultes et Cabrera* 17137.—Río Vaupés, near Mitú. November 13, 1952. *Schultes et Cabrera 18409.*—Río Apaporis, Raudal Yayacopi. August 18, 1952. *Schultes et Cabrera 16963.* Río Kubiyú, savannah Goo-ran-hoo-dá. June 30, 1958. *García-Barriga, Schultes et Blohm 16061.*

This common and relatively widespread species has one important use: the leaves, which are inhabited with fierce ants,

are gathered and reduced to ashes. The ashes are reputedly the best type for mixing with clay used in pottery and ceramics. The product must be excellent to make it worthwhile braving the ferocity of the ants!

The Puinave name of this bushy treelet is *mũin* or *mũin-wan-she-pe-ne:* the latter name means "*mũin* for pottery." The Yukuna call the plant *ka-roo-wö'* and the Makuna *hoo-be'-gee.*

Tachigalia myrmecophila *Ducke* in Arch. Jard. Bot. Rio Jan. 3 (1922) 91.

COLOMBIA: Comisaría del Vaupés, Río Negro, Caño Ducuruapo. "Large tree along river bank. Flowers yellow. December 13–17, 1947. *Schultes et López 9389.*—Río Kananarí. "Tree. Flowers yellow, very fragrant." August 6, 1951. *Schultes et Cabrera 13421.*

The ashes of this plant are mixed with clay to strengthen pottery.

Tachigalia paniculata *Aublet* var. **comosa** *Dwyer* in Ann. Mo. Bot. Gard. 41 (1954) 240, t. 10, fig. 9.

COLOMBIA: Comisaría del Amazonas, Río Loretoyocu. September 1946. *Schultes et García-Barriga 8360.*—Same locality. September 1946. *Schultes 8266.*

Comisaría del Vaupés, Río Apaporis, Jinogojé. September 3–11, 1952. García-*Barriga 14418.*—Río Vaupés, Cachivera de Tatú. "Large tree, 35–40 feet tall. Flowers pink. September 27–October 20, 1966. *Schultes, Raffauf et Soejarto 24389.*

This species is alkaloid negative with a Dragendorff reagent spot test in the field. The leaves formerly were burned for mixing with powdered coca (*Erythroxylon Coca* Lam. var. *Ipadu* Plowman) leaves.

Tachigalia ptychophysca *Spruce ex Bentham* in Martius, Fl. Bras. 15, pt. 2 (1870) 299.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Raudal Jerijerimo. "Tree 12 m. tall. Petals yellow, stamens white." July 7, 1951. *Schultes et Cabrera 12955.*—Same locality. "Tree 60 feet tall. Flowers yellow. August 7, 1951. *Schultes et Cabrera 13488.*—Mouth of Río Pacoa. July 18, 1951, *Schultes et Cabrera 13082.*

A vigourous rubbing of the crushed leaves of *Tachigalia ptychophysca* is believed by the Taiwano Indians to be alleviative for the stings of the fierce ants inhabiting this species.

Tachigalia Schultesiana *Dwyer* in Bot. Mus. Leafl., Harvard Univ. 18 (1858) 152.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Raudal de Jerijerimo. "Large tree. Flowers yellow." September 16, 1951. *Schultes et Cabrera 14045.*

A decoction of the flowers of *Tachigalia Schultesiana* is considered by the Taiwanos to be a cure for tuberculosis when it is gargled hot daily for several weeks. Only the flowers are used.

LINACEAE

Roucheria calophylla *Planchon* in Hooker, Lond. Journ. BOt. 6 (1847) 141.

COLOMBIA: Comisaría del Amazonas, Río Apaporis, Soratama. Alt. c. 900 feet. "Flowers yellow. Small tree." January 1952. *Schultes et Cabrera 19862.*

The Taiwano Indians use the bark of this tree in decoction as a favourite "cure" for malaria.

MALPIGHIACEAE

Diacidia glaphimioides *Grisebach* in Mart., Fl. Bras. 12, pt. 1 (1858) 120.

COLOMBIA: Comisaría del Vaupés, Río Kuduyarí, Cerro Yapobodá. "Low bush, 1–2 feet tall. Flowers yellow." October 5–6, 1951. *Schultes et Cabrera 14355.*—Río Karurú, Mesa de Yambí, Savannah Goo-ran-hoo-da'. April 15–16, 1953. *Schultes et Cabrera 19170.*—Río Vaupés, Mitú and vicinity. Cerro de Mitú. "Vine. Flowers with petals bright yellow, stamens and base of petals salmon-red." May 28, 1976. *Zarucchi 1674.*

The Kubeos of the upper Río Kuduyarí value the flowers of this vine for preparing a cataplasm for an illness that causes swollen glands of the neck. The vine bears flowers most of the year.

Diplopteris involuta (*Turcz.*) *Niedenzu* in Pflanzenr., Heft 91, 4, 1 Fam. 141, pt. 1 (1928) 226.

PERU: Departmento de Huánuco, Provincia de Pachitea. Bosque Nacional de Iparia. Alt. 300–400 m. "Liana de 15–17 m. Flores amarillas con sepalos de color pardo oscuro. Frutos immaturos. September 26, 1967. *Schunke V. 2179.*

According to the collector, the local vernacular name of this liana is *ayahuasca negro.*

There is no evidence—except the possible nomenclatural intimation—that this species enters into the narcotic preparation known in Peru as *ayahuasca.* It is possible, however, that this species has, like *Diplopteris Cabrerana* (Cuatr.) Gates, tryptamine constituents (Schultes et Hofmann: *The Botany and Chemistry of Hallucinogens* [Ed. 2] (1980) 175).

SAPINDACEAE

Paullinia rugosa *Bentham ex Radlkofer,* Monogr. Serjan. (1875) 75.

COLOMBIA: Comisaría del Vaupés, Río Kuduyarí, Savannah Yapobodá. Alt. c. 300 m. "Bejuco. Fruto rojo-sangre; arilo blanco. Semilla negra." June 23–25, 1958. *García-Barriga, Schultes et Blohm 16019.*

The Kubeo Indians of the Mitú region consider that the leaves of *Paullinia rugosa* have emetic properties.

STERCULIACEAE

Guazuma ulmifolia *Lamarck,* Encycl. 3 (1789) 52.

COLOMBIA: Comisaría del Amazonas, Río Caquetá, La Pedrera. May 2, 1952. *Schultes et Cabrera 16370.*

A gum from the fruit is valued in La Pedrera in the treatment of sore throat and bronchial infections.

Sterculia apetala (*Jacq.*) *Karsten,* Fl. Columb. 2 (1862) 35, t. 118.

COLOMBIA: Comisaría del Amazonas, Río Loretoyaco. Alt. c. 100 m. September 1946. *Schultes et Black 8386.*

Comisaría del Putumayo, Río Sucumbios, Santa Rosa and vicinity. Very tall tree. Flowers yellow-white. April 7–8, 1942. *Schultes 3641.*

The Kofán Indians report that they formerly prepared an oil from the seeds which was employed in treating skin eruptions.

Sterculia pruriens (*Aubl.*) *K. Schumann* in Martius, Fl. Bras. 12, pt. 2 (1886) 8.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, between Ríos Pacoa and Kananarí. "Large tree. Flowers yellowish red. Highland." September 15, 1951. *Schultes et Cabrera 13987.*

The Takanos, who call this tree *ko-ree,* maintain that the oil extracted from the seeds has several medicinal uses, especially for treating "sarna" (mange).

FLACOURTIACEAE

Euceraea nitida *Martius,* Nov. Gen. et Sp. 3 (1829) 90, t. 238.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, summit of Cerro Isibukuri. January 23–25, 1952. *Schultes et Cabrera 15035; 15039.*

The leaves of *Euceraea nitida* are reputedly poulticed on boils and other skin infections to soften the skin and hasten suppuration.

Laetia procera (*P. et E.*) *Eichler* in Martius, Fl. Bras. 13, pt. 1 (1871) 453.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Jinogojé. "Scandent bush. Fruit pink, fleshy." August 2, 1952. *Schultes et Cabrera 17018.*

The Makú Indians, who call this bush *yaw'-tee,* employ the fragrant flowers crushed and mixed with oil for the treatment of "sarna", a mange-like cutaneous itch. The mixture is applied several times a day to the affected area.

Ryania angustifolia (*Turcz.*) *Monachino* in Lloydia 12 (1949) 21.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, La Jirisa. January 9, 1944. Gutiérrez *et Schultes 560.*—Río Apaporis, Raudal Yayacopi. February 18, 1952. *Schultes et Cabrera 15491.*

The Kubeos call this plant *cruheric* and state that it was formerly employed for its high toxicity for killing animals.

Ryania pyrifera (*L. C. Rich.*) *Uitten et Sleumer* in Pulle, Fl. Surinam 3 (1935) 286.

COLOMBIA: Comisaría del Vaupés, forest between Ríos Vaupés and Apaporis, from Puerto Naré to Puerto Victoria. April 10–17, 1943. *Schultes 5360.*

This species is reported to have been employed in former times on the Río Vaupés to poison animals.

Tetrathylacium macrophyllum *Poeppig et Endlicher,* Nov. Gen. et Sp. 3 (1843) 34, t. 240.

COLOMBIA: Comisaría del Putumayo, path between Puerto Ospina and Concepción. "Bush, 8 feet." April 20–23, 1942. *Schultes 3673.*

This plant is locally regarded as having poisonous fruits.

THYMELAEACEAE

Schoenobiblus peruvianus *Standley* in Field Mus. Publ. Bot. 11 (1936) 169.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. October 1946. *Schultes et García-Barriga 8418.*

This species is one of the preferred curare plants amongst the Kofán Indians of the Colombian Putumayo and adjacent Ecuador (Schultes: Bot. Mus. Leafl., Harvard Univ. 13 (1949) 289).

The Tikunas of the Río Loretoyacu recognize the bark of the stem and root as toxic but have no knowledge of its use in preparing curare.

The Tikunas have long had great fame as curare-makers. Their curare was made basically from Strychnos and species of several menispermaceous genera. Krukoff, who investigated Tikuna arrow poisons in great depth, failed also to list *Schoenobiblus peruvianus* as one of the ingredients of Tikuna curare (Krukoff and Smith: Bull. Torr. Bot. Club 64 (1937) 401–409.).

LECYTHIDACEAE

Asteranthos brasiliensis *Desfontaines* in Mem. Mus. Paris 6 (1820) 9, t. 3.

COLOMBIA: Comisaría del Vaupés, Río Guainía, Puerto Colombia. "Bush. Flowers yellow. Bracts green." October 31 - November 2, 1952. *Schultes, Baker et Cabrera 18214.*

The bark of the stem and root of this bush are employed in the form of a decoction as a strong purgative amongst the Kuripakos of the Río Guainía.

Chytroma gigantea (*Kunth*) *Kunth* in Pflanzenr. Heft 105, 4. Fam. 219a (1935) 85.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. October 1946. *Schultes et Black 8558.*

The Tikuna Indians add the dried flowers in the form of a powder to fermented chicha prepared from *Manihot esculenta* Crantz.

Chytroma turbinata *(Berg) Miers* in Trans. Linn. Soc. 30 (1874) 234.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. September 1946. *Schultes et Black 8280.*

The flowers of *Chytroma turbinata* are dried, powdered and mixed with chicha, a fermented Manihot drink amongst the Tikuna Indians; the purpose of this use of the flowers is unknown.

Chytroma valida *Miers* in Trans. Linn. Soc. 30 (1874) 241.

COLOMBIA: Comisaría del Vaupés, Mitú, base of Cerro Mitú. "Flowers yellow-cream, fragrant." September 27–October 20, 1966. *Schultes, Raffauf et Soejarto 24250.*

The leaves and bark of this tree are alkaloid-negative with a Dragendorff reagent spot test.

Eschweilera inaequisepala *Cuatrecasas* in Fieldiana, Bot. 27, no. 2 (1951) 87.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Mitú. September 27–October 20, 1966. *Schultes, Raffauf et Soejarto 24186.*

A Dragendorff spot test for alkaloids on the fresh leaves and bark was negative.

Eschweilera iquitoensis *Kunth* in Engler, Pflanzenr., Lecythidac. 97 (1939) 111.

COLOMBIA: Comisaría del Vaupés, Río Piraparaná. August 24, 1952. *Schultes et Cabrera 17010.*—Río Kukuyarí. August 12, 1960. *Schultes et Cabrera 22585.*

The Makuna Indians living on the Río Piraparaná burn the bark and mix very small amounts of the ashes in their *mingau* (flour of *Manihot esculenta* with water) in the belief that the ashes act as a vermifuge.

Eschweilera sp.

COLOMBIA: Comisaría del Amazonas, Río Miritiparaná, Caño Guacayá. "Small tree. Flowers yellowish or pinkish, fragrant." April 24, 1952. *Schultes et Cabrera 16284.*

Comisaría del Vaupés, Río Kuduyarí. "Small tree. Flowers white basally, pink at tips." October 16, 1952. *Schultes et Cabrera 17874.*

The Kubeo call this tree *doo'-kö*; amongst the Yukunas of the Río Miritiparaná, the plant is known as tee-ree'-*ma-ree.*

Grias Neuberthii *Macbride* in Field Mus. Publ. Bot. 11 (1931) 30.

COLOMBIA: Departamento del Cauca, Río Caquetá, Puerto Limón. February 28–29, 1942. *Schultes 3312.*

Comisaría del Putumayo, Uchupayacu. February 22–23, 1942. *Schultes 3292.*—Río Sucumbios, Quebrada Conejo. April 2–5, 1942. *Schultes 3479.*

ECUADOR: Provincia Pastaza, Río Chico village. August 1979. *Schemluck et Ness 184.*

The vernacular name of this tree in the Putumayo is *kokora.* Amongst the Kofán Indians, it is called *te-te-koo'-choo.* The

rind of the fruit is edible when ripe. The twigs are added to the mixture when curare is being prepared from *Strychnos Jobertiana* Baill.

The cambium is used by the Indians of Río Chica "to induce vomiting in malarial cure." It is also "given at childbirth to induce vomiting thereby reducing nausea and improving appetite." The seed is employed as an enema for treating dysentary. The common name of this species in Ecuador is *pitun-ruya*.

Gustavia calycaris (*Berg*) *Miers* in Trans. Linn. Soc. 30 (1874) 185.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. "Small tree in inundated area along river's edge. Flowers pink." March 1946. *Schultes 7216.*—Same locality. January 28–February 7, 1969. *Plowman, Lockwood, Kennedy et Schultes 2432.*

The local name of this tree is *matamatá*. In the Río Loretoyacu, the bitter root is considered to be purgative; a tea of the fruits is emetic.

Gustavia longifolia *Poeppig ex Berg* in Martius, Fl. Bras. 14, pt. 1 (1848) 472.

COLOMBIA: Comisaría del Putumayo, Umbria. December 1930. *Klug 1980.*

The vernacular name of this species is *kokora*. The Siona Indians of the Putumayo point this tree out as one of the ingredients formerly employed (the bark) in their preparation of curare.

COMBRETACEAE

Combretum laxum *Jacquin,* Enum. Pl. Carib. (1760) 19.

COLOMBIA: Comisaría del Amazonas, Río Igaraparaná, La Chorrera. June 4-10, 1942. *Schultes 3924.*—Río Putumayo, Florida. May July 1931. *G. Klug 2337.*

Comisaría del Vaupés, Río Apaporis, Soratama. July 18, 1951. *Schultes et Cabrera 13079.*—Same locality. August 16, 1951. *Schultes et Cabrera 13588.* Same locality. "Vine. Flowers white, very fragrant of narcissus." September 15, 1951. *Schultes et Cabrera 13979.* Same locality. January 28, 1952. *Schultes et Cabrera 14992.*

The very fragrant flowers of this vine are valued as personal adornments by the Indians.

Native names for this plant in the Vaupés are: Puinave, *der'-gaw;* Kuripako, *tee'-ye-pee;* Tukano, *o-ree';* Barasana, *beh'-ma;* and Kubeo, *ne-he-ve-mon'*. The Witotos of La Chorrera call the plant *ajuo-wo* or *aioho-ayo-o.*

Combretum rotundifolium *Richard* in Act. Soc. Hist. Nat. Paris 1 (1792) 108.

COLOMBIA: Comisaría del Amazonas, Río Igaraparaná, between Quebrada Menaje and Río Putumayo. June 15–17, 1942. *Schultes 3984.*—Río Amazonas, Leticia. September–November, 1944. *Schultes 6196a.*

Comisaría del Vaupés, Río Apaporis, Soratama. June 26, 1951. *Schultes et Cabrera 12839.*

The Tukano Indians of the Río Apaporis call this vine *o-ree'-ma-ka.*

LOGANIACEAE

Strychnos brachiata *Ruiz et Pavon,* Fl. Peru. et Chil. 2 (1799) 30.

COLOMBIA: Comisaría del Putumayo, Río Sucumbios, Santa Rosa. "Vine." April 7–8, 1942. *Schultes 3602.*

The Kofán Indians, who know this vine as *se'-he-pa* ("poison"), use the root as one of their major curare sources.

Strychnos cogens *Bentham* in Hooker, Journ. Bot. 3 (1841) 241.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. October 1946. *Schultes et Black 8525.*

Strychnos cogens was one of the major species employed in the preparation of curare by the Tikuna Indians. The Tikuna name is *iko.*

Strychnos Erichsonii *Rich. Schomburkg,* Fauna Fl. Br. Guian. (1848) *nomen; ex Pragel* in Martius, Fl. Bras. 6, pt. 1 (1868) 274.

COLOMBIA: Comisaría del Putumayo, Río Sucumbios, Conejo. April 2 5, 1942. *Schultes 3524.* Comisaría del Vaupés, Río Apaporis, Soratama, June 18,

1951. *Schultes et Cabrera 12644.*—Río Popeyacá. "Vine. Fruit orange." February 25, 1952. *Schultes et Cabrera 15653.*—Río Apaporis, Jinogojé. June 20, 1952. *Schultes et Cabrera 16770.*—Same locality. August 17, 1952. *Schultes et Cabrera 16882.*—Same locality. August 25, 1952. *Schultes et Cabrera 17021.* August 22–24, 1952. *García-Barriga 14580.*

This widespread species was first reported from Colombia in 1949 (Schultes, Bot. Mus. Leafl., Harvard Univ. 13 (1949) 290). Since that report, many collections have been made in Colombia, indicating that it is one of the commonest species of Strychnos in the northwest Amazonia.

It is regarded by all Indians who still manufacture curare in the area as the most potent species.

The Makú Indians of the Río Piraparaná in Colombia, who make the most prized curare, know the vine as *koo-ee-et'*. The Makuna call it *wa-oo-nee'-ma-ma.* The Kofán name is *ir-ro'-chee;* the Desano *lee-ma-na-joo'*; the Karijona, *e-re-qui'*.

Strychnos guianensis (*Aubl.*) *Martius,* Syst. Mart. Med. Bras. (1843) 121.

COLOMBIA: Comisaría del Putumayo, upper Río Putumayo, *Schultes 3421.* Río Sucumbios. April 1942. *Schultes 3688.*—Río Putumayo, Nueva Granada. "La corteza de la raiz tiene resina rojiza que se utiliza para veneno de flechas." July 30, 1957. *Idrobo 2633.*

The Siona Indians, who call this vine *ya-hi-ae-o,* employ the bark of the root for preparing curare. The root bark is a minor component of one of the curares prepared by the Kofáns who know the plant as *ku-see-ye'-he-pa.*

Strychnos javariensis *Krukoff* in Brittonia 4 (1942) 279.

COLOMBIA: Comisaría del Putumayo, Río Putumayo, Puerto Ospina. "Vine. Root used in preparing arrow poison by Kofánes." April 25, 1942. *Schultes 3690.*—Same locality and date. *Schultes 3691.*

Comisaría del Amazonas, Río Loretoyacu. October 1946. *Schultes et Black 8401.*

The Tikuna Indians chew the bark of *Strychnos javariensis* to relieve toothache.

This species represents one of the ingredients of lesser potency in Kofán curares.

Strychnos Jobertiana *Baillon* in Adansonia 12 (1879) 367.

COLOMBIA: Comisaría del Putumayo, Río Sucumbios, Conejo. "Bark of root used for curare." April 2–5, 1942. *Schultes 3523.*—San Antonio de Guaumués. "Bark rasped and boiled for curare." September 6, 1966. *Pinkley 431.*—Same locality. September 6, 1966. *Pinkley 432.*

Comisaría del Amazonas, Río Loretoyacu. November 1946. *Black et Schultes 46-262.*

First reported from the Colombian flora in 1949 (Schultes, loc. cit., 290), it is now known to be widespread in the northwest Amazonia, where the root is one of the preferred sources of curare.

The Kofán names of this species are *u-su-se-e'-pa, ee-ru-chee-se'-he-pa, kitsi-pa-cho-se'-he-pa* and *fee-see-pa'-chu.*

Strychnos Mitscherlichii *Schomburkg,* Faun. Fl. Brit. Gian. (1848) 950.

COLOMBIA: Comisaría del Putumayo, Río Putumayo, Nueva Granada. "Se raspa, se separa la corteza, se reune con otros varios bejucos y se cocina en largo proceso para preparar el veneno. Mata todo animal, pero no asienta en la preparación. July 29, 1957. *Idrobo 2628; 2632.*

Comisaría del Amazonas, Río Loretoyacu. September 1946. *Schultes et Black 8388.*

The Sionas of the Putumayo have two names for this vine: *pux-se-o* ("cayman poison") and que-he-ae-o ("vine rough to the touch"). The bark is one of the ingredients of their curare.

Strychnos panurensis *Sprague et Sandwith* in Kew Bull. 1927. (1927) 132.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Soratama. June 26, 1951. *Schultes et Cabrera 12840;*—Near mouth of Río Pacoa. July 18, 1951. *Schultes et Cabrera 13084.*

Comisaría del Amazonas, Río Loretoyacu. September 1946. *Schultes et Black 8388.*

Widespread in the northwest Amazon, *Strychnos panurensis* is valued by numerous tribes as an ingredient in curare.

Strychnos Peckii *L. B. Robinson* in Proc. Am. Acad. 49 (1913) 504.

COLOMBIA: Comisaría del Putumayo, Río Sucumbios, Santa Rosa. April 7–8, 1942. *Schultes 3601.*

Comisaría del Vaupés, Río Negro, vicinity of Piedra del Cucuy. December 27, 1947. *Schultes et López 9491.*—Río Apaporis, near mouth of Río Kananarí. March, 1951. *Schultes 12100.*

The Kofán Indians prepare curare from the root of this species. They refer to it simply as *se'-he-pa* ("poison").

This species is apparently the principal ingredient of the curare prepared by the Karaparanas of the Río Kananarí.

Strychnos rondeletioides *Spruce ex Bentham* in Journ. Linn. Soc. 1 (1856) 104.

COLOMBIA: Comisaría del Amazonas, Río Karaparaná, El Encanto. "Bush. Fruit blue-black or orange-red." May 22–28, 1942. *Schultes 3829.*

Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. September 27 - October 20, 1966. *Schultes, Raffauf and Soejarto 24187; 24248; 24258.*—Same locality. November 13, 1952. *Schultes et Cabrera 18408; 18416; 18423.*

This widespread species in Amazonian Brazil, Bolivia and Peru and in Venezuela is now known to be an abundant element of the riverine vegetation of southeastern Colombia.

Strychnos Solererderi *Gilg* in Engler, Bot. Jahrb. 25, Beibl. 60 (1898) 40.

COLOMBIA: Comisaría del Amazonas, Leticia. September 7, 1963. *Soejarto 595.*—Río Caquetá, La Pedrera, Cerro Cupatí. September 30, 1952. *García-Barriga 14522.*

The Yukuna Indians of the Río Miritiparaná near La Pedrera know this species as *a-pa-can'-juin.*

Strychnos subcordata *Spruce ex Bentham* in Journ. Linn. Soc. 1 (1856) 106.

COLOMBIA: Comisaría del Putumayo, Río Putumayo, Puerto Ospina. "Vine." April 25, 1942. *Schultes 3687.*

First reported from Colombia in 1949. (Schultes, loc. cit. 43), this species is widespread and rather common near abandoned

sites in the western Amazon of Brazil. *Schultes 3687* established its range to the foothills of the Andes.

The Kofán Indians employ the root in one of their arrow-poison formulas. They know the vine as *su-se'-pa.*

RUBIACEAE

Calycophyllum obovatum (*Ducke*) *Ducke* in Trop. Woods no. 49 (1937) 2.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Cachivera de Jerijerimo and vicinity. Alt. c. 250 m. "Bush." June 13, 1951. *Schultes et Cabrera 12474.*

An emetic drink is prepared from the leaves of *Calycophyllum obovatum* by the Indians residing in the middle course of the Río Apaporis. It is taken when the frequent food poisoning from eating tainted meat or fish is experienced.

Calycophyllum Spruceanum (*Bth.*) *K. Schumann* in Martius, Fl. Bras. 6, pt. 6 (1889) 191.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. Alt. c. 100 m. November 1944. *Schultes 6332.*—Puerto Nariño, Río Loretoyaca. February 14, 1973. *Glenboski C-276-A.*

This tree, locally known as *capirona* and *palo mulato,* is employed by the Tikuna Indians as a source of rafters for their houses.

The bark is said to be very astringent and is employed in decoction for treating sore throat.

Cephaelis Humboldtiana *Chamisso ex Schlechtendal* in Linnaea 4 (1829) 136.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Cachivera de Jerijerimo and vicinity. Alt. c. 250 m. "Bracts red-purple. Bush 2–2½ feet tall." June 10, 1951. *Schultes et Cabrera 12499.*

Comisaría del Amazonas. Interior region of Trapecio Amazónico between Amazon and Putumayo watershed. Alt. c. 100 m. "Bush. Bracts red. Flowers white." October 1945. *Schultes 6894.*

In the Río Apaporis, the Karapana Indians prepare a decoction of the leaves of *Cephaelis Humboldtiana* for treating malarial fevers.

Cephaelis Williamsii *Standley* in Field. Mus. Publ. Bot. 8 (1930) 185.

COLOMBIA: Comisaría del Putumayo, Río Uchupayaco, Uchupayacu, between Urcusique and Umbría. Alt. c. 300 m. "Large bush. Fruit green." February 23, 1942. *Schultes 3298.*

The Siona Indians point out this plant as a source of a febrifugal tea.

Duroia hirsuta (*P. et E.*) *K. Schumann* in Martius, Fl. Bras. 6, pt. 6 (1889) 367.

COLOMBIA: Comisaría del Putumayo, Río Sucumbios, Conejo. Alt. 300 m. April 5, 1942. *Schultes 3536.*

The bark of this small tree is caustic. A band of the bark is tied around the arm and kept for several days. After it is removed, the skin develops a red irritation and blisters, as if the skin had been burnt. The irritated area then turns blue-black, leaving the mark which persists for a month or longer (Schultes: Bot. Mus. Leafl., Harvard Univ. 22 (1969) 152; Schultes in *II Simposio de la Biologia Tropical Amazónica* (1970) 194–195.)

This cosmetic use of the bark is frequent in a number of Indian tribes in the Putumayo, but it is an especially common practice amongst the Kofán where one finds hardly a man who does not have the blue-black decoration on one or both arms. The Kofán call *Duroia hirsuta sha-ka-ker'-na-se.* The name in Spanish is *solimán.*

Isertia hypoleuca *Bentham* in Hooker, Journ. bot. 3 (1841) 220.

COLOMBIA: Comisaría del Amazonas, Leticia. September 20, 1945. *Schultes 6540.*—Same locality. September 7, 1963. *Soejarto 574.*—Same locality. August 1964. *Raffauf 110.*

In the Leticia area, the inhabitants powder the leaves of this common weedy treelet to apply to sores of the lip which appear to be herpes. An infusion of the leaves is said to have anti-asthmatic properties but in high doses may be poisonous.

Isertia rosea *Spruce ex K. Schumann* in Martius, Fl. Bras. 6, pt. 6 (1889) 284.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, Cachivera Palito. July 25, 1951. *Schultes et Cabrera 13148.*

The Indians of the Río Kananarí take a warm tea of the leaves for treating bronchial conditions.

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SACRED PLANTS OF THE SAN PEDRO CULT

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The high northern Andean valley of Huancabamba, Peru, is the centre of an extraordinary moon-oriented magico-religious healing cult, a fundamental feature of which is the nocturnal ingestion by patients and curandero of the mescaline-rich San Pedro cactus (*Trichocereous Pachanoi* Britton et Rose). Such is the notariety of the curanderos, or *maestros,* of Huancabamba that patients regularly arrive not only from the Peruvian coastal cities and the scattered settlements of the Maroñon river drainage area to the east, but from as far away as Argentina, Chile, Colombia and Ecuador.

The healing process at Huancabamba involves two equally important phases. During the first, the *maestro,* under the influence of the San Pedro, divines the cause of the patient's predicament and prescribes a cure. The adherents of the cult believe that all of life's vicissitudes result from supernatural causes; hence commonly treated problems include both psychological and physiological disorders as well as chronic bad luck, marital troubles, sorcery and malevolent curses (Sharon 1978). The second phase of the curative process includes the treatment of the particular problem by means of folk remedies prepared from medicinal plants, the most efficaceous of which are said to grow in the environs of a number of sacred lakes known as Las Huaringas. Especially problematic cases are led by the *maestro* on pilgrimages to these lakes, located a hard day's walk above Huancabamba at an elevation of approximately 10,500 feet. In completing the pilgrimage and in bathing in the sacred waters, the penitent believes that he or she undergoes a metamorphosis, a spiritual regeneration that is profoundly curative (Schultes and Hofmann 1979, Sharon 1972, 1978).

The dynamics of the Huancabamba cult have been discussed in some detail by a number of authors (Schultes and Hofmann 1979, 1980, Dobkin de Rios 1968, 1969, Sharon 1972, 1978, Friedberg 1959, 1960, 1963, 1980). The purpose of this paper is to introduce a number of novel ethnobotanical observations which I was able to make during my fieldwork in the region in 1981, including the discovery of a cactus previously unreported as an hallucinogen and a folk legend that offers evidence of the continuity of indigenous religious beliefs in the otherwise thoroughly "mestizada" culture of contemporary Huancabamba. For comparative purposes an account of the nocturnal curing ritual is presented.

Of the antiquity of the use of the San Pedro cactus in northern Peru there can be no doubt. Engraved stone carvings at Chavin dating to 1300 B.C. feature an anthropomorphic figure clutching a section of the cactus (Schultes and Hofmann 1979). Representations of the cactus show up on Chavin textiles, Nazca ceramic urns and Moche and Chimú ceramics (Schultes and Hofmann 1979, Friedberg 1963, Sharon 1978) and Towle (1961) has suggested that cacti were probably under domestication on the coast of Peru as early as the Early Intermediate (200 BC-600 AD).

A far greater challenge has been to establish continuity between the pre-Columbian use of this cactus and the present day cults. Historically, contact between western societies and indigenous societies in the New World stimulated novel adaptations as the indigenous societies were forced to adapt themselves to phenomena outside the range of their traditional experiences. Messianic movements in North America are one well known adaptation of this nature, but one closer to the Huancabamba example is found in the intensification of shamanistic activity among South American groups under the pressure of contact and acculturation (Harner 1973, Hudelson 1981). In the early postcontact era, the indigenous population of the entire north coast of Peru, including the adjacent regions of the Andean cordillera, was utterly devastated (Rowe 1948); and, as late as the mid-18th century, much of the region remained depopulated (Von Hagen 1964). Under such pressures, the indigenous

religious practices, including the utilization of *Trichocereus Pachanoi,* undoubtedly were thoroughly transformed.

Today, in marked contrast to the indigenous Quechua populations of the southern Peruvian Andes, the rural population of the Huancabamba and surrounding valleys is totally *mestizo.* No indigenous languages, textiles, forms of social organization or agricultural practices remain. True, remnants of aboriginal religious beliefs and practices have persisted, yet over the centuries they have been so fully influenced by Christianity that, in the syncretic result, it is often difficult to distinguish one tradition from the other (Sharon 1978). In fact, so rich is the overlay of Roman Catholic symbolism on the contemporary cults that early observors concluded that they represented a strictly post-contact, colonial phenomenon. Ethnohistorical evidence, while indicating that without doubt *Trichocereus Pachanoi* was used in some regions of 17th and 18th century Peru (Oliva 1895, Cobo 1956), is insufficient to allow the initial transformations of the indigenous religions and the subsequent evolution of the contemporary cults to be precisely characterised. In the absence of complete ethnohistorical data, evidence of the continuity of indigenous beliefs must be sought in a synchronic study of the symbolism of the cult as it exists today. In this regard, it is pertinent to repeat at some length a remarkable folk belief that I encountered near Huancabamba.

Whilst walking from Huancabamba to Las Huaringas, I noticed a particularly large stand of *Trichocereous Pachanoi* (voucher, herbarium specimen, *Davis 760*) growing at the Caseria Laumache, approximately three miles from Huancabamba. As I approached the stand, I was astonished to discover that a single clone covered perhaps one quarter of an acre; individual shoots towered to 45 feet, and some fallen sections measured 14½ inches in diameter. In order to collect specimens, I borrowed a machete from a nearby *campesino* who then followed me anxiously towards the San Pedro. As I entered the stand, he most emphatically urged me to hurry; when I attempted to pass him my cut specimens, he eased towards the edge of the stand with the utmost caution. Then, as he gazed over my shoulder, he suddenly yelled and flung himself face first

to the ground. Somewhat unnerved by his behavior, I hastened to complete my collections.

Later, upon reflection, I was most curious as to why such a stand, growing a mere five minutes from the principle trail to Las Huaringas, had not been harvested. At that time San Pedro sold in the coastal markets for 500 soles (about $1.00 US then) a one-foot section of about eight inch girth. As a result, virtually all escaped populations of the San Pedro cactus in the valley had been harvested. Yet here was a single unmolested stand of literally tons of the cactus. When I questioned my main informant, a particularly esteemed maestro, don Pancho Guarnizo[1], he gravely asked me how far into the stand I had ventured. When I replied that I had merely made some collections on the periphery, he sighed in relief and mentioned that in that case I would not die but merely break out with a horrible pestilence.

That special clone of San Pedro, he warned me, is protected by an enormous serpent living at the centre of the stand. The snake does not bite intruders but rather, as a spirit guardian of the plant, causes repugnant diseases to break out —a plague "like measles that causes small bumps all over the body." The cactus itself was reputedly the strongest in the valley, but no maestro dared to use it. Hence the stand is never disturbed.

The pestilence referred to in the legend quite possibly is the dreaded verruga, or Clarion's disease, an affliction known only from Peru, where it is localised in certain valleys of the western slope of the first range of the cordillera, including that of Huancabamba. It is caused by a recently identified bacillus (*Bartonnella bacilliformis*) which causes a temporary eruption

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[1] My principle informant at Huancabamba was don Pancho Guarnizo, a highly regarded *maestro* and a proud member of the Asociación de Naturalistas Evangélicas del Peru. The Guarnizo family emigrated to Peru from Ecuador some 150 years ago, and for several generations has been closely associated with the cult. Don Pancho was apprentised to his grandfather, a well known maestro from Las Huaringas, and in turn has passed his remarkable knowledge on to a number of individuals now practising as *maestros* in the Huancabamba area. Only recently did don Pancho himself move from Las Huaringas to the outskirts of Huancabamba and the family retains a house at Taleneo, near the Laguna Negra, whence one of the sons directs the ceremonies at the sacred lakes. A second son, José, is a noted herbalist who has compiled a list of over 3000 medicinal plants which he is attempting to print in the coastal city of Piura. José is the "pharmacist" to whom don Pancho refers his patients for herbal treatments.

of wart-like excrescences, mainly on the face but often covering much of the body. Pizarro's men, it will be remembered, suffered a severe case of the disease while exploring the flanks of the sierra east of Tumbes:

> "They thought at first that these were warts, because at the beginning they looked like warts. But as time passed, they grew larger and began to ripen like figs, of which they had both the size and shape: they hung and swung from a stem, secreted blood and body fluids, and nothing was more frightful to see or more painful, because they were very sensitive to touch. The wretched men afflicted with this disease were horrible to look at, as they were covered with these purple-blue fruits hanging from their foreheads, their eyebrows, their nostrils, their beards and even from their ears; nor did they know how to treat them. Indeed some died of then while others survived. Then it suddenly disappeared the way it had come, as do bad attacks of the grippe." (de la Vega 1961: 375)

Perhaps coincidentally, two weeks after leaving Huancabamba, I suffered a dermatological disorder that covered my entire face and neck with blemishes; undiagnosed the attack disappeared after a fortnight.

This folk legend recounted by Pancho Guarnizo contains a number of symbolic elements typical of traditional South American shamanism, including: 1) the belief in spirit guardians; 2) the notion of particular geographical localities animistically endowed with supernatural power — the image of the serpent; 3) the concept of physical combat against disease demons or spirits; 4) the close association of certain magical plants with spiritual power and the idea that different individual populations of the same botanical species may be endowed with greater or lesser amounts of power; and finally 5) the belief in spiritual or supernatural forces as the causal agents of illness. The legend, in fact, exemplifies a fundamental feature of the contemporary San Pedro healing cult. Despite the overlay of Catholic symbolism, the aboriginal roots of the cult are readily apparent in every phase of divinatory and curative ritual.

On the night of February 15, 1981, I participated in a San Pedro healing ceremony under the guidance of don Pancho Guarnizo. A long brown muddy track wove past agaves swollen in flower and arrived at an open veranda contiguous with a

complex of farm houses. The patients sat passively on rough benches along one wall of the enclosure; at their feet lay the offerings that each must bring for the ceremony: a bottle of alcohol, a bag of white sugar, and one bottle each of *agua florida* (scented water) and *agua cananga* (red perfume). Each of the patients had already consulted the *maestro* and the healing process began at that first encounter; some of the patients had been waiting all day, and this period of inactivity before the ceremony appears to be a deliberate part of the ritual. There is a space specified for the purpose, and the *maestro*, while providing food, remains aloof and interacts very little with the waiting patients.

The patients exemplified the ecletic troubles treated by the *maestros*. There was a father and a daughter from Mendoza, near Chachapoyas in the Marañon basin. Until recently, the girl had been paralyzed, and though partially treated by a *brujo* ("witchdoctor") from Bague, she still suffered severe back and stomach pains and a general psychological depression. Further, a mysterious ailment had reduced the family's cattle herd from 58 to six head; and, to make things worse, an aunt had recently gone mad. The aunt had been too sick to travel; hence the father presented coins and hex stones in her proxy. Another patient was a business man from the coastal city of Sullana who wanted to discover the identity of the culprit who had embezzled 800,000 soles (US–1500.00 then) from his business. The final patient was insane. Several weeks before, he had discovered his wife in the arms of another man. The forsaken husband had gone for a gun, but the temporary lover was quick of tongue. He had cursed the husband, warning him that a murder would be avenged in heaven, and that, in the meantime, he would face life in a Peruvian jail. According to don Pancho, the words had fallen "like clumps of sod across a hollow coffin". The husband had collapsed in convulsions, during the course of which he went mad.

The *maestro* appeared shortly after ten. His body was wrapped in a deep blue poncho, and his enormous hat added years to his aspect. All that was visible was his elephantine nose and a chin that resembled the toe of an old boot. Holding a

flickering lamp, he announced simply that it was time to begin.

Behind the house, on a sheltered porch six colonial swords stuck into the ground marked the outline of the *mesa,* or ceremonial alter, before which the patients were directed to sit. From several bags, the *maestro* withdrew the power objects of the *mesa.* These included wooden staffs of tropical hardwoods (membrillo—*Cydonia oblonga* Mill., chonta—*Bactris gasipaes* HBK, ajohaspi—*Cordia* sp.) whale bones, quartz crystals, colonial knives, plastic toy soldiers, pre-Columbian ceramics and *huacas,* brass lions and deer, antlers, wild boar tusks, silver plates, murex and helmet shells, dice, statues of the virgin and many photographs, paintings and figurines of the Roman Catholic saints. There was in the placement of these objects the care and the inherent eye for the sacred that characterises the true *maestro* (Sharon 1978: 159–176). A single item from the offerings of each patient was placed before the alter.

The ceremony began with an invocation to Christ and the Virgin:

> "Long live luck, work, fortune, business: obstacles, problems, here I go stopping, I go dallying, in good times, in bad times, with the grace of God and the most holy Virgin that this tobacco provide my patients with all their solutions, with my good tobacco, and the good mountains and lakes, the good herbs and my good tobacco—leaf for leaf, vein for vein, root for root, shoot for shoot, whether in Piura, in Lima or in Cajamarca where died our King Atahualpa—pieces of gold, bells of silver. Likewise shall ring out my name, the name of my family, my luck, my work, my fortune and my business with the grace of God and the most Holy virgin."

Following the opening prayer, there must be a *pago*, a payment, and hence the *maestro* sprayed alcohol and perfume to the cardinal points and over each of the patients. During the course of the ceremony, each patient's bottle of perfume would be emptied and returned as a *seguro*, a sacred protection made up of herbs gathered at Las Huaringas. Following the *pago,* don Pancho brought out a large bowl in which tobacco leaves were soaking in an alcohol/perfume solution. He took a bottle of aguardiente and poured the contents over the leaves, and then massaged the leaves with his hands. Next he dipped a scallop

shell into the brew and instructed each patient to inhale the liquid through his or her left nostril, a procedure immediately followed for the right nostril. This *florecimiento* was repeated periodically throughout the night. After inhaling each sample, we were instructed to walk to the open end of the veranda, to shake our bodies vigorously to "release the force". That end of the open aired temple appeared to represent the interface between the inner and the outer; the shrine as sanctuary and the outer world as the place of darkness and spirits.

The next hour was punctuated by numerous invocations and litanies reflecting both Roman Catholic and indigenous origins, which were invariably followed by *florecimientos.* At one point close to midnight, we were told to rise; and a large cauldron of liquid was brought from the kitchen. A single cup of the San Pedro preparation was passed repeatedly in a clockwise direction, until each patient had drunk three cupfuls. By now, the night was growing, and the temptation to sleep struck all patients. The *maestro* talked incessantly, beseeching us to refrain from sleeping, and as the San Pedro began to take effect, a dialogue began between each patient and the *maestro* during which the particular ailments were diagnosed. Each participant was considered individually, with don Pancho pausing to massage or suck on various parts of the patient's body to extract the supernatural source of the afflictions. The diagnosis was accompanied by ritualistic songs and chants and the rhythmic shaking of the sacred rattle. After the diagnosis, the patients lay down around the *mesa*, and attempted, sometimes in vain, to heed the maestro's warning to remain awake[2]. Just before dawn, the man from Sullana lept to his feet, and rushed with a pair of wooden staffs to the edge of the veranda yelling:

> "Away evil, away things of the night. We now have the power through the grace of don Pancho Guarnizo and so away things of the night!"

A long series of grandiose accusations, boasts and threats followed, which he accentuated with violent thrusts of the staffs. Then, as the man returned to the *mesa,* each patient orally sprayed aguadiente and perfume across the staffs.

A ritualistic purification began at dawn. The *maestro* rubbed each participant with a series of stones and sticks from the *mesa*. He massaged the limbs, pulling on each joint of our fingers; then spinning the patient, he hit each one with a switch on the back, and hurried the patient to the end of the veranda, as he yelled an order to shake violently. Then the apprentices took over, rubbing each patient with black round stones, white rocks, crystals of quartz and finally melted glass. There followed another rub down, first with two wooden staffs and then with two colonial swords. Finally, with the aid of the two staffs placed across the chest of the patient, the apprentice swung him or her off the ground, violently shaking the lower part of the body. The swords were placed in the form of a cross on the ground and the patient was led ceremoniously across the threshold that the swords represented.

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[2]The actual intoxicating effect of the San Pedro was minimal. During his first three sessions with San Pedro, at least, it is clear that Sharon himself did not become intoxicated (Sharon 1972: 133–135). In part explaining his own failure to be affected by the psychoactive preparation, he stresses that "much more than the psychoactive cactus itself is at work in learning to 'see'. To see, to attain vision beyond what we would call the real world requires hard work, lengthy training and most important a very special kind of psychological predisposition combined to cultural conditioning" (Sharon 1972: 117). While acknowledging that, in general, a shaman's ability to interpret the hallucinogenic vision is a highly evolved skill, I fear that I must consider the rather prosaic matter of dosage. Having self-experimented on a number of occasions with two species of Trichocereus (*T. Pachanoi* and *T. Bridgesii* Britton et Rose) and having experienced extremely strong psychoactive intoxications during each experiment, I would argue that I was quite adequately predisposed to experience mescaline narcosis. Yet during neither of the two sessions in which I participated at Huancabamba did I, my similarly experienced assistant, nor any of the participants become noticeably intoxicated. In fact, a number of experienced students of psychotomimetic drugs have commented informally on their repeated frustration when participating in indigenous rituals involving psychoactive plants (Plowman, Weil, McKenna, Schultes pers. com.). This may be a reflection of psychological and physiological predisposition on the part of the western participants. Luis Luna (1983) has written a fascinating paper suggesting that a particular ritualistically prescribed and rigidly followed diet greatly enhances susceptibility to *ayahuasca* (*Banisteriopsis Caapi* (Spr ex Griseb) Morton). In the San Pedro cults, however, and perhaps in other cases, it appears to be, at least partially, a rather mundane matter of dosage. The *maestro* clearly controls access to the spiritual realm in the sense that a Roman Catholic priest is the only conduit through which the believer can partake of what he believes is the body of Christ. The sub-threshold dosages certainly do not realize the complete pharmacological potential of the hallucinogen. Rather, the hallucinogens may have become symbolically analogous to the Eucharist. Perhaps the *maestro*, himself utterly familiar with the visionary world illuminated by the psychoactive plants, retains a firmer control on the access to that spirit realm than has been commonly assumed.

After each patient had been thus treated, all the participants in the ceremony did a number of *florecimientos*, after which the *maestro* blew perfume, aguadiente, sugar and facial powder over all of us. After a final benediction, the ceremony ended. Each participant was presented with his *seguro*, the perfume bottle full of sacred herbs from las Huaringas.

Although I afterwards spent several days at Las Huaringas and bathed in the sacred Laguna Negra, I did not participate directly in the second phase of the healing ceremony. Sharon (1978), however, provides the following description:

> "After the opening invocation, don Florentino approached all the participants and poured a small portion of herbal remedy from his *seguro* into their palms. This was imbibed through the nostrils by all present... Next don Florentino instructed us to prepare for the bath. Undressing to our underwear, we entered the water, tossng offerings of silver coins and sweet limes sprinkled with sugar into the lagoon. We were next instructed to wade ashore briefly and then return to the lagoon for a quick final dip. As we came out of the water for the second time, the curandero blessed each of us and then instructed us to jump up and down and wave our arms to get warm. Once dried, we were allowed to dress.
>
> Once dressed, each of us picked up the amulets and good luck charms we had brought with us and bathed them in the lagoon. Then, one by one, we took a turn before don Florentino for a "cleansing", or rubbing with his large sword. Then an assistant blew white powder over our chests, and the curer sprayed us orally with liquid from his bottle of magical plants. Then each participant orally sprayed perfume and sweet wine over the lagoon. To end the ceremony, we brought our artifacts before the curandero to be blessed in the name of the lagoon—a process that consisted of invoking the lagoon, calling out our names, and then orally spraying the artifacts with the herbal liquid from the *seguro*." (Sharon 1978: 131)

While living with don Pancho Guarnizo's family at Taleneo, near Las Huaringas, I made a number of collections which may partially clarify lingering questions concerning the botanical identification of certain plants associated with the Huancabamba cults. Sharon (1972: 122) draws the distinction between the plethora of medicinal plants utilised by the *maestro* and the magic plants which, although also medicinal, are endowed with particular spirit powers. In the former group would be a

number of medicinal plants found commonly throughout the Huancabamba valley. For example, an infusion of the leaves of *yatama* (*Salvia discolor* HBK) (*Davis 683*) is taken internally for stomach indigestion. The leaves and stems of the *flor de guayacan* (*Tecoma stans* var. *velutina* DC) (*Davis 683*) is drunk to treat tuberculosis. The solanaceous *hierba del aire* (*Lycopersicon hirsutum* Dunal) (*Davis 680*) provides a general tonic, while the rhizomes of certain ferns known as *calaguala* (e.g. *Niphidium sp.*) are employed in infusions for relieving liver ailments.

The magic plants, many of which are locally found only around the sacred lagoons, may be employed medicinally, but are also used for the *seguros* or as additives to the hallucinogenic potions. As medicines, the spirit plants are considered especially powerful. For example, an infusion of the ground leaves of *pegapega* (*Befaria resinosa* Mutis ex. L.) (*Davis 703*) mixed with honey is the strongest recognized treatment for respiratory ailments. A decoction of the entire *chagapa morada* plant (*Gentianella formosissima* (D. Don ex G. Don) Fabris ex Pringle) (*Davis 751*) in aguadiente is drunk for yellow fever. A similarly prepared decoction of *chagapa roja* (*Gentianella sp.*) (*Davis 702*) is a highly regarded febrifuge. An infusion of *huachumillo* (*Baccharis genistelloides* (Lam.) Per.) (*Davis 674*) is drunk to treat inflamations. An unidentified member of the Juncaceae—*hierba de dominacion*—is a magical plant that allows one to dominate enemies, as it insulates one's "forces of white magic from the power of evil". One of the most important of the Huaringas plants is *hornamo morado* (*Valeriana adscendens* Turz.) (*Davis 756*), a powerful purgative that is sometimes added to the San Pedro preparations. Sharon (1972, 1978) reports a series of additives under the generic term "hornamo"—*hornamo blanco, hornamo amarilla, hornamo morado, hornamo cuti, hornamo caballo.* Although only *hornamo morado* was specifically identified by my informant, it is significant that at least three other species of *Valeriana* (*V. malvacea* Graelsn. (*Davis 743*), *V. Mutisiana* (Wedd.) Hoch. (*Davis 752*) and *V. microphylla* HBK. (*Davis 753*) were found

growing near Las Huaringas. The roots of *Valeriana officinalis* L. contain valerianic acid which, when ingested in medicinal doses, acts as a stimulating tonic, anti-spasmodic and calmative. Excessive doses result in headaches, mental excitement, visual illusions, giddiness, restlessness, agitation and spasmodic movements (Hutchens 1973: 286).

The magic plants recognized by don Pancho Guarnizo are by no means found only besides the sacred lakes. San Pedro grows predominantly at the lower elevations in the environs of Huancabamba. Also close to Huancabamba, found only on the steep slopes of an isolated geological formation known as the Cerro Colorado, there occurs a second species of psychoactive cactus named *pishicol* (*Armatocereus laetus* (HBK.) Backeberg) (*Davis 759*). This plant, previously unreported as an hallucinogen, is an extremely rare endemic known from only four localities, all in northern Peru: Jaen, east of the Abra Porculla on the boundary of the departments of Piura and Cajamarca, Sondorillo, and Huancabamba on the Río Huancabamba (Zimmerman pers. comm.). It is a tall columnar, night-blooming cactus (12 feet), with erect, articulated branches with six to eight ribs. According to Dr. Allan Zimmerman, an expert in the neotropical Cactaceae, there are two other *Armatocereus* species in the region, but "one (*A. Rauhii* Backeb. has shorter spines and is a tall slender tree; the other (*A. Ghiesbreghtii* (K. Schumann) Ritter. var. *oligogonus* (Rauh. et. Backeberg) Ritter.) has stems that are only four to five ribbed." (Zimmerman pers. comm.).

Pishicol is considered by don Pancho Guarnizo to be as powerful as San Pedro and is prepared and ingested in a similar way: that is, three or four pieces a foot and a half long are sliced transversely, placed in a five gallon can of water and boiled for several hours. Phytochemical analysis of the species is now underway, and the results will be presented in a future publication.

An outstanding ethnobotanical problem associated with the Huancabamba cults yet adequately to be resolved concerns the botanical meaning of the term *cimora*. Cruz-Sánchez (1948: 253) suggested that cimora was the term applied to a particular

intoxicating blend of plants that included, in addition to San Pedro (*Trichocereus Pachanoi*), "el *Pedillanthus titmaloides* sp. [sic] (*cimora misha* or 'planta magica'), la *Isotoma longiflorum* [sic] (*cimora toro* or *misha veneno*), la *Datura stramonium* (*el chamico*)". In addition to these, he referred to a number of unidentified plant additives by their vernacular names, including "la *cimora misha blanca, la cimora misha curandera, la cimora misha rastrera, la cimora misha galga, la cimora misha huaquera, la cimora misha adivadora, la cimora misha amarilla, la cimora misha morada".* Friedberg (1960: 25) disagreed with Cruz-Sánchez and stated that cimora "is not a drink composed with a cactus but is a plant of the Amaranthaceae in the genus *Iresine*". She also identified the vernacular name *misha* as specifically applying to the solanaceous *Datura arborea.* In the same paper, however, she stated that San Pedro or *Huachuma,* as it is known in the northern sierra, had three locally recognised varieties: "*la curandera, la huachuma misha* and *la huachuma rastrera".* When Schultes (1967) reviewed the problem, he cited an earlier paper of Friedberg (1959) in which *Iresine* is referred to as *timora,* a "magic and dangerous herb" (Friedberg 1959: 443). Friedberg (1959: 448) also reported that a number of varieties of *Datura arborea — misha —* are identified by various animal names which she did not specify. She did mention three locally recognized forms of *timora—timora lanza, señ*orita, and *sanguracha.* Schultes (1967: 39), not surprisingly, questioned whether *cimora* and *timora* might not be two forms of the same word. The anthropologists Sharon (1972, 1978) and Dobkin de Ríos (1968, 1969, 1977) simply repeated Friedberg's earlier determinations without reference to new voucher specimens. Schultes and Hofmann (1980) consider *cimora* a beverage made up of a number of plants (sensu Cruz-Sánchez 1948); but as authorities they cited Dobkin de Ríos (1977) and Friedberg (1959). Dobkin de Ríos (1977) made no mention of *cimora* and Friedberg (1959) used the term *timora,* not *cimora.* This minor oversight on the part of Schultes is understandable because Friedberg (1980: 38) used the two terms interchangeably, both again in reference to the amaranthaceous genus *Iresine.'*

My own findings from the field, though by no means definitive, do have the advantage of being based on voucher specimens. It is worth noting that, quite by coincidence, my contact at Huancabamba and Las Huaringas, don Pancho Guarnizo appears to have been Friedberg's major informant (Friedberg 1963: 249–254). According to José Guarnizo, the herbalist son and colleague of Pancho Guarnizo, *cimora* is a conceptual term referring to "algo malo"—something bad. In this sense, he recognized a number of locally distinguished forms of *Brugmansia* × *candida* Pers. (identified by earlier students as *Datura arborea* L.) as *cimora oso* (*Davis 670*), *cimora galga* (*Davis 672, 671, 687, 757, 758*) and *cimora toro curandero* (Davis 673, 686). Other uncollected *cimoras* which he compared morphologically with *Brugmansia* × *candida* were *cimora aguila, cimora leon, cimora rastrera.* Although all of my collections have been identified as *B.* × *candida,* these unidentified vernacular names may refer to some of the other species of *Brugmansia* reported from the valley (*Brugmansia insignis* (B. Rodrigues) Lockwood, *B. suaveolens* (H. et B. ex Willd.) Bercht et Presl., and *B. versicolor* Lagerh.) (Friedberg 1980). According to José Guarnizo, these brugmansias, which he also referred to as *mishas,* were rarely added to the San Pedro preparations. Rather, the curandero, when faced with a particularly difficult case, might ingest these powerful plants alone, and thus divine the source of the particular affliction.

Timora, according to my findings refers to a number of plants, including *Euphorbia cotinifolia* L. (*Davis 673a*) and *Iresine celosia* L. (*Davis 688*). *Iresine,* although not known to have biodynamic principles, has a reputation among the maestros for curing insanity (Schultes and Hofmann 1979). It is of note that a related amaranthaceous plant, *Alternanthera Lehmannii* Hieron. is known to the Ingano Indians of southern Colombia as *borrachera,* "intoxicant" and they add it to their *ayahuasca* preparations to increase the psychotomimetic properties of the drink (Schultes 1957).

In summary, the term *cimora* appears to be a generic term which may be applied to a number of plants, specifically the brugmansias and perhaps, if Cruz-Sanchez was correct, the

euphorbiaceous *Pedilanthus tithymaloides* Poit. as well as the campanulaceous *Hippobroma longiflora* (L.) G. Don. (= *Isotoma longiflora* L.). Since I was unable to collect voucher specimens of the latter two species, the complete meaning of the term *cimora* still remains somewhat uncertain. Schultes (1967: 39) in reference to the identification of *cimora* has stated:

> "Here is one of the most challenging problems in the ethnobotany of hallucinogenic plants, and one which would not be difficult to investigate thoroughly."

Today, nearly fifteen years later, and despite the attention that numerous ethnobotanists and anthropologists have given the Huancabamba cults, this fundamental clarification remains to be made.

ACKNOWLEDGMENTS

The field work reported here was funded in part by the Social Science and Humanities Research Council of Canada (Doctoral Fellowship) and in part by the Inter-American Foundation and the Atkins Fund of Harvard University. I would like to thank Dr. Michael Dillon, Dr. Timothy Plowman, Ms. Penny Matekaitis, Dr. Allan Zimmerman, and Mr. Steven Clements for identifying specimens and Prof. Richard Evans Schultes for reviewing the manuscript. During the fieldwork, I was ably assisted by Ms. Etta Turner. Finally, my deepest gratitude goes to don Pancho Guarnizo, his son José and his entire family who received and sheltered me in Huancabamba and at Las Huaringas and who shared with me their remarkable spiritual insight. Voucher specimens are deposited in the Economic Botany Herbarium of Oakes Ames at the Botanical Museum, Harvard University and the Field Museum of Natural History, Chicago.

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PLATE 41

Plate 41. San Pedro *(Trichocereus Pachanoi)* at Cataluco, near Huancabamba.

PLATE 42

Plate 42. José Guarnizo, son of don Pancho Guarnizo, at Cataluco with harvested San Pedro *(Trichocereus Pachanoi)* (Davis 677).

PLATE 43

Plate 43. Pishicol *(Armatocereus laetus)* on the slope of Cerro Colorado with the town of Huancabamba in background.

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CARVED 'DISEMBODIED EYES' OF TEOTIHUACAN

JONATHAN OTT[1] AND R. GORDON WASSON[2]

Situated a few hours' drive northeast of Mexico City are the magnificent ruins of Teotihuacan, dating from the beginning of the first millennium A.D. Best known for two large, stepped pyramids (Pyramids of the Sun and Moon) and the smaller, more ornate Pyramid of Quetzalcoatl, the ruins abound in numerous low, labyrinthine buildings which are decorated with beautiful and complex mural paintings. The comparatively well-preserved Tepantitla murals are best known to scholars, a prominent segment having been restored and repainted in the Teotihuacan room of the Museo Nacional de Antropología in Mexico City by Agustín Villagra Caleti. Portions of many other murals survive at Teotihuacan, while some, such as the important Zacuala murals, which are unprotected from the elements, are scarcely visible today.

In his 1973 book *The Mural Painting of Teotihuacan* (1), Arthur G. Miller drew attention to the prominence of the 'disembodied eyes' which occur repeatedly in the mural paintings of Teotihuacan. Figures 1–4 illustrate some typical examples of the recurrent 'disembodied eyes', motif. One of us (J.

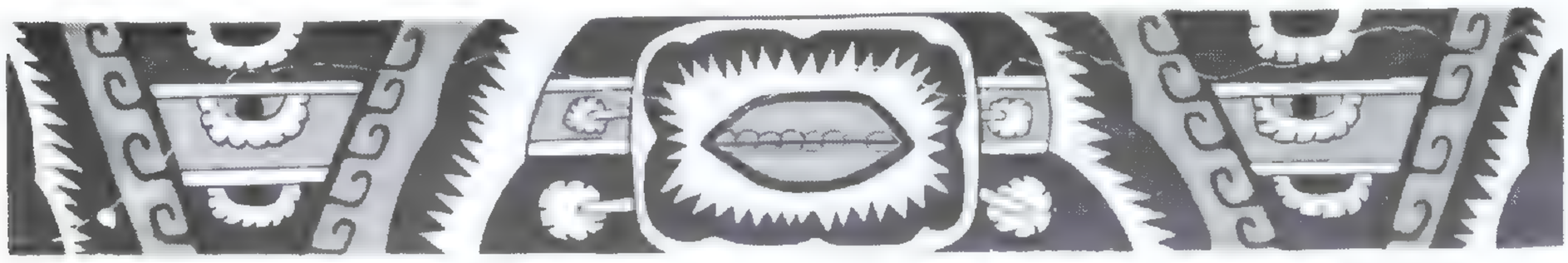

Figure 1. 'Predella' from Zacuala, Teotihuacan, repainted by Abel Mendoza. Notice 'disembodied eyes' flanking central motif representing four mushrooms surrounding the radiant 'logos'.

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Figure 2. Drops of entheogenic potion with appended 'disembodied eyes' from Teotihuacan murals. Reproduction by Margaret Seeler.

O.), during a recent visit to Teotihuacan, was struck by the ubiquity of these 'disembodied eyes', indeed, it was difficult to escape the sensation of being watched constantly.

We here comment on the existence of 'disembodied eyes' in relief carvings at Teotihuacan. The carvings are found on columns in a courtyard of a structure known as the Palace of Quetzalpapálotl*, located at the west corner of the square adjacent to the Pyramid of the Moon (Plates 44 & 45). The face

Figures 3 & 4. Drops of entheogenic potion and appended 'disembodied eyes' issuing from entheogenic flowers. Reproduction of fragments of Tepantitla murals by Margaret Seeler.

*The Palace of Quetzalpapálotl was excavated in 1962 and summarily restored under the direction of Mexican archaeologist Jorge R. Acosta. The structure dates from the sixth century A.D., belonging to the Teotihuacan III and IV eras. Details of the excavation and restoration can be found in Acosta's book *El Palacio del Quetzalpapá*lotl (Instituto Nacional de Antropología e Historia, México, 1964).

of each column in the courtyard is adorned with two rows of four 'disembodied eyes' arrayed above and beneath a carving of a bird (Plate 46). The carved eyes are realistic and are inlaid with obsidian 'pupils' (Plates 47 & 48). The identification of the carvings as eyes is unequivocal—witness the corresponding inlay of obsidian to the eyes of the creature in the carvings, which represents a chimera called Quetzalpapálotl, 'quetzal bird/butterfly' (Plate 46). It is perhaps significant that the eye of the bird is round, as in nature birds' eyes appear, whereas the 'disembodied eyes' are distinctly anthropomorphic, with upper and lower 'eyelids' giving the 'eyeballs' an ovoid shape. On the north, south and east sides of the courtyard, the columns identically depict the avian chimera in profile (Plate 46), whereas the columns on the west side show a frontal view, possibly of the same creature (Plate 49).* The columns are surmounted by a broad lintel painted with a repeated motif, which in turn is crowned by a series of carved stone 'combs' (Plates 50 & 51).

In his book on the murals of Teotihuacan, Miller drew no conclusions as to the meaning of the 'disembodied eyes' or of the murals as a whole. One of us (R.G.W.) has proposed that the 'disembodied eyes' represent the visionary sight of the shaman or participant in an agape involving ingestion of a potion compounded of entheogenic mushrooms, morning glory seeds, or other plants with allied effects. This interpretation is based on the occurrence of mushrooms, flowers and seeds in juxtaposition with the 'disembodied eyes' (*vide* Figures 1–4), and the association of the eyes with green drops issuing from the flowers (green, the color of jade, signifies religious value), drops which are symbolic of the entheogenic potion. This theory is laid out in detail in *The Wondrous Mushroom: Mycolatry in Mesoamerica* (2), which further suggests that the labyrinthine buildings of Teotihuacan, decorated with these entheogenic motifs, were groups of cenacula in which sacramental ingestion of entheogens

*Scholars have differed on the question whether one or two birds are here depicted. In a recent paper (*Ethnos* 32: 5–17, 1967) Arthur G. Miller summarizes the evidence and concludes that the bird depicted frontally represents an owl, whereas the bird depicted in profile represents the quetzal. Acosta, in his comments regarding his reconstruction of the columns, identified the profile birds as quetzal bird/butterfly chimeras, hence the name Quetzalpapálotl.

took place. The carved 'disembodied eyes' of the Palace of Quetzalpapálotl are further evidence confirming this hypothesis.

The 'disembodied eye' motif is not restricted to Mesoamerican art. Figure 5 illustrates the design on a gold ring, *circa* 1500 B.C., from Crete. The scene probably depicts an epiphany of the Great Mother goddess Artemis (the figure on the right) in the form of an anthropomorphic bee (3). The hierophants who attended the Ephesian Artemis were called *Essenes* or 'King Bees' and the later Greek mother goddesses, such as Rhea and Demeter, were attended by priestesses called *Melissae*, 'Bees' (4). It would seem that the four figures on the left of the ring represent the *Melissae*, bee-priestesses worshipping the goddess. A 'disembodied eye' is clearly represented near the center of the composition, between the goddess and her devotees. Here we have a representation of a visionary scene, from an Old World

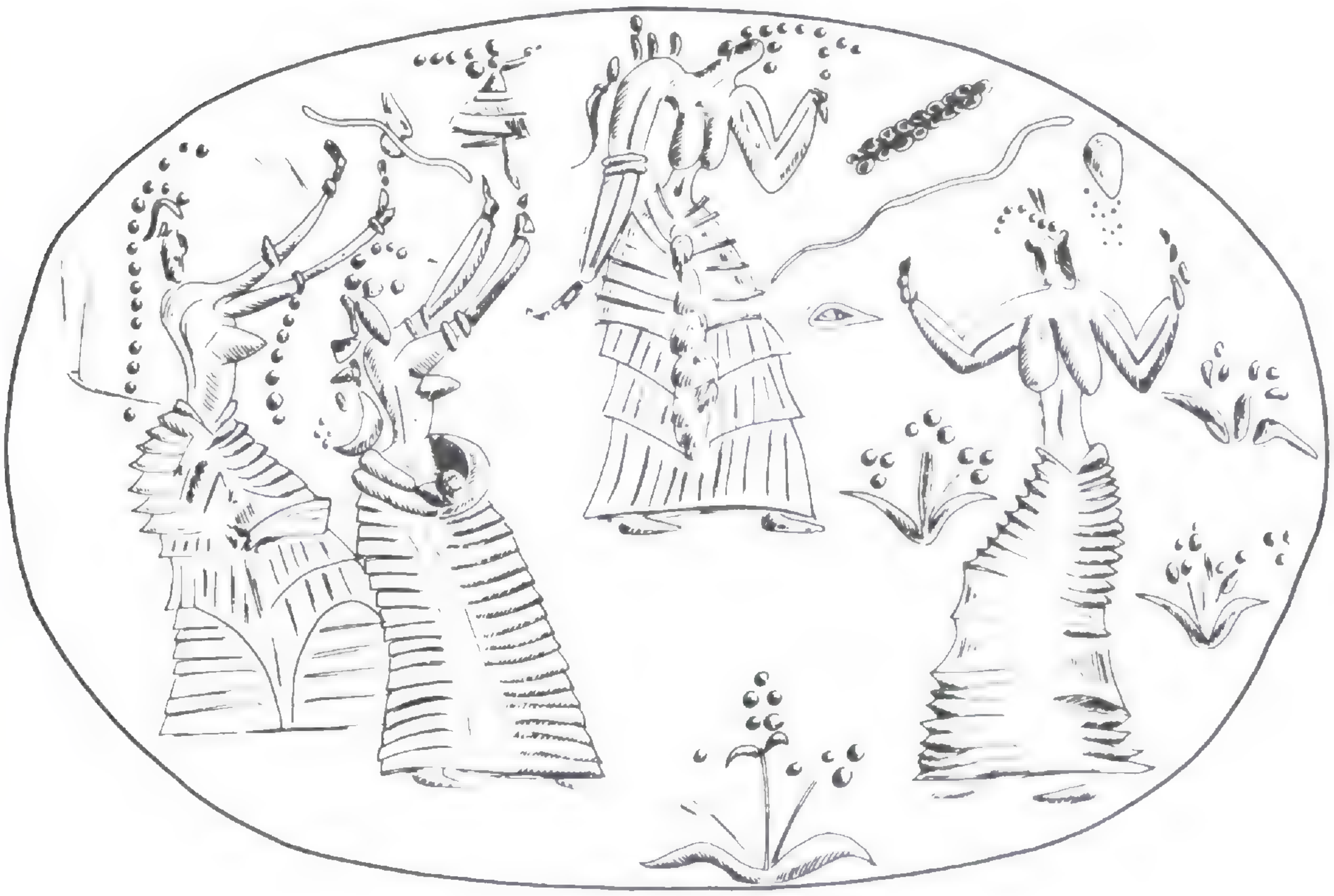

Figure 5. Gold ring of Isopata near Knossos, greatly enlarged. Scene depicts epiphany of goddess (presumably Artemis) on the right, and four worshippers, all represented as anthropomorphic bees. Note 'disembodied eye' in center, and plants (presumably entheogenic) surrounding goddess.

culture and antedating by two millennia the murals of Teotihuacan, yet accompanied also by a 'disembodied eye'. We now know that the Greek culture practiced religious rites based on ingestion of entheogenic potions (5–7), and it is not unreasonable to assume that earlier cultures, such as the Minoans and Mycenaeans, had similar rituals. Does not the Minoan ring from Crete depict an entheogenic vision of the goddess and her devotees in their mythological forms, as human/bee chimeras? It is significant that the goddess on the ring is surrounded by plants, presumably the source of the entheogenic potion.

The carvings of 'disembodied eyes' in the Palace of Quetzalpapálotl echo a motif common in murals found throughout the ruins of Teotihuacan. What can the 'disembodied eyes' represent, other than the visionary eye of the seer under the influence of one or other of the well-known pre-Columbian entheogens? Indeed, the image of the 'disembodied eye' suggested itself to one of us (R.G.W.) as a natural metaphor for the state produced by ingestion of entheogenic mushrooms. Written more than 25 years ago, in 1957 (8), long before the appearance of Miller's book and without his having seen the 'disembodied eyes' of the murals or columns, R.G.W.'s words are apposite:

> There I was, poised in space, a disembodied eye, invisible, incorporeal, seeing but not seen.

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PLATE 44

Plate 44.. Looking north at Teotihuacan, with Pyramid of the Moon at right and Place of Quetzalpapálotl at left in foreground.

PLATE 45

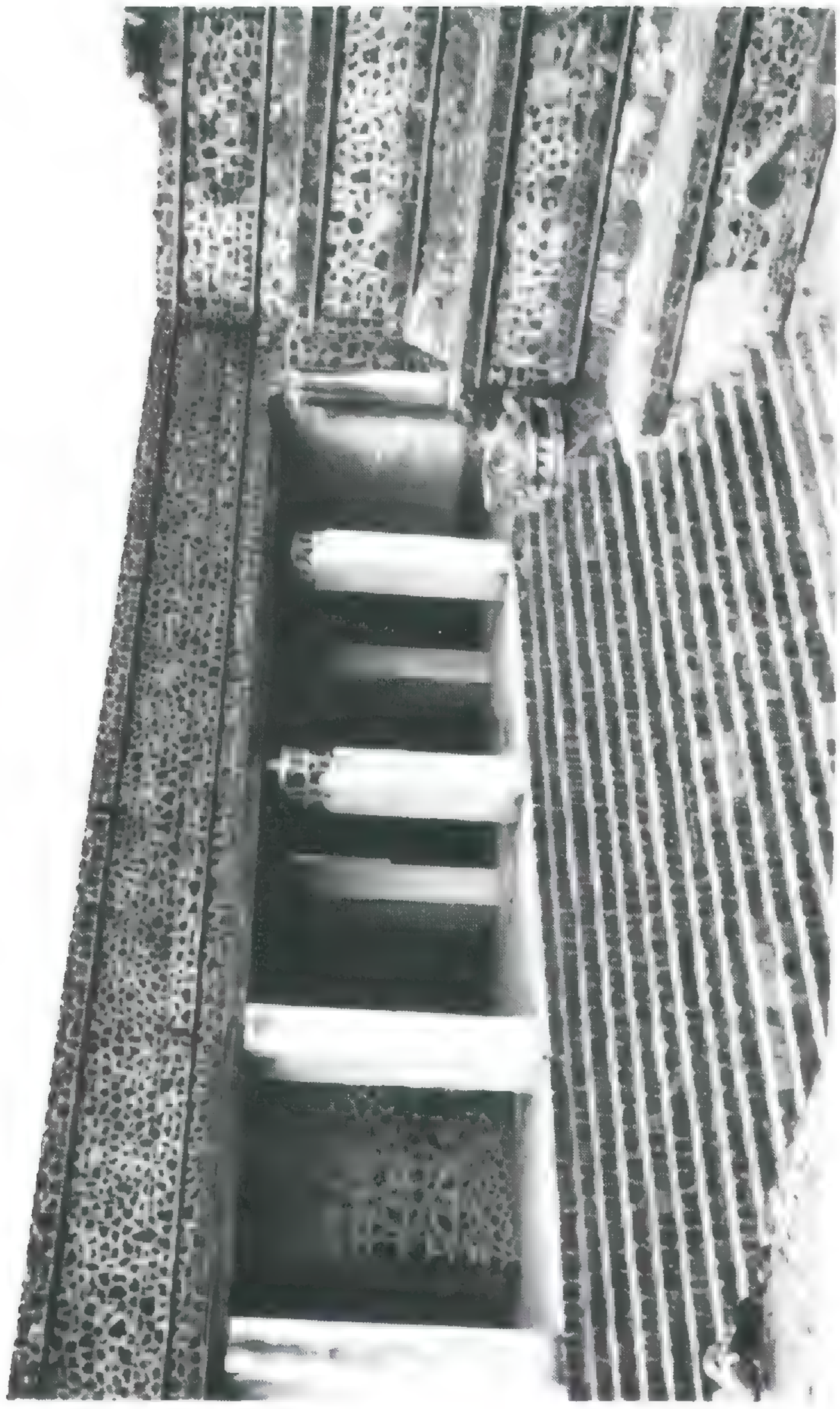

Plate 45. Entrance to Palace of Quetzalpapálotl at Teotihuacan.

PLATE 46

Plate 46. Column showing Quetzalpapálotl chimera and 'disembodied eyes'.

PLATE 47

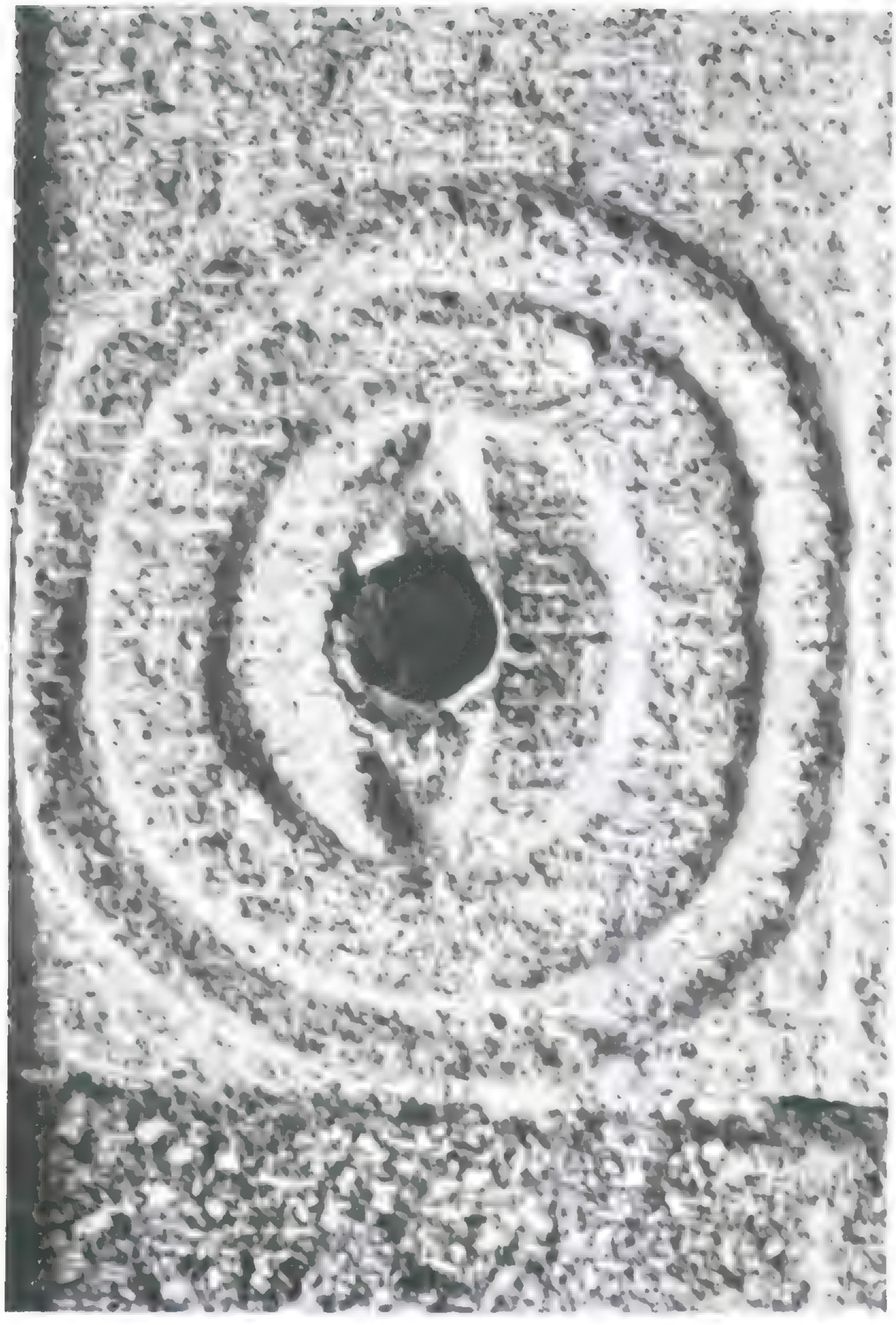

Plate 47. Closeup of 'disembodied eye' from column. Note inlaid obsidian 'pupil' and anthropomorphic 'eyelids'.

PLATE 48

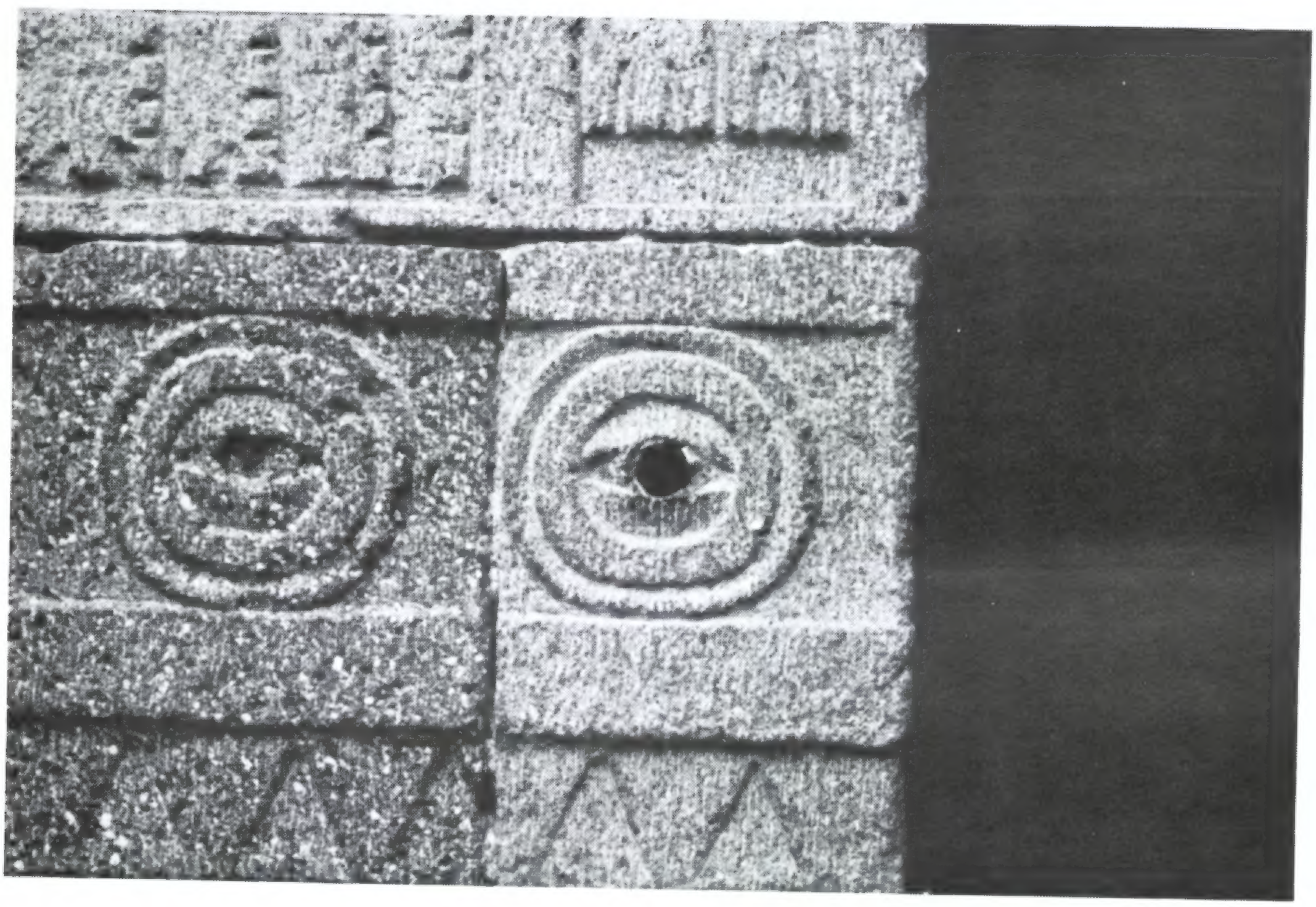

Plate 48. Closeup of 'disembodied eyes'.

PLATE 49

Plate 49. West column with frontal view of avian creature and 'disembodied eyes'.

PLATE 50

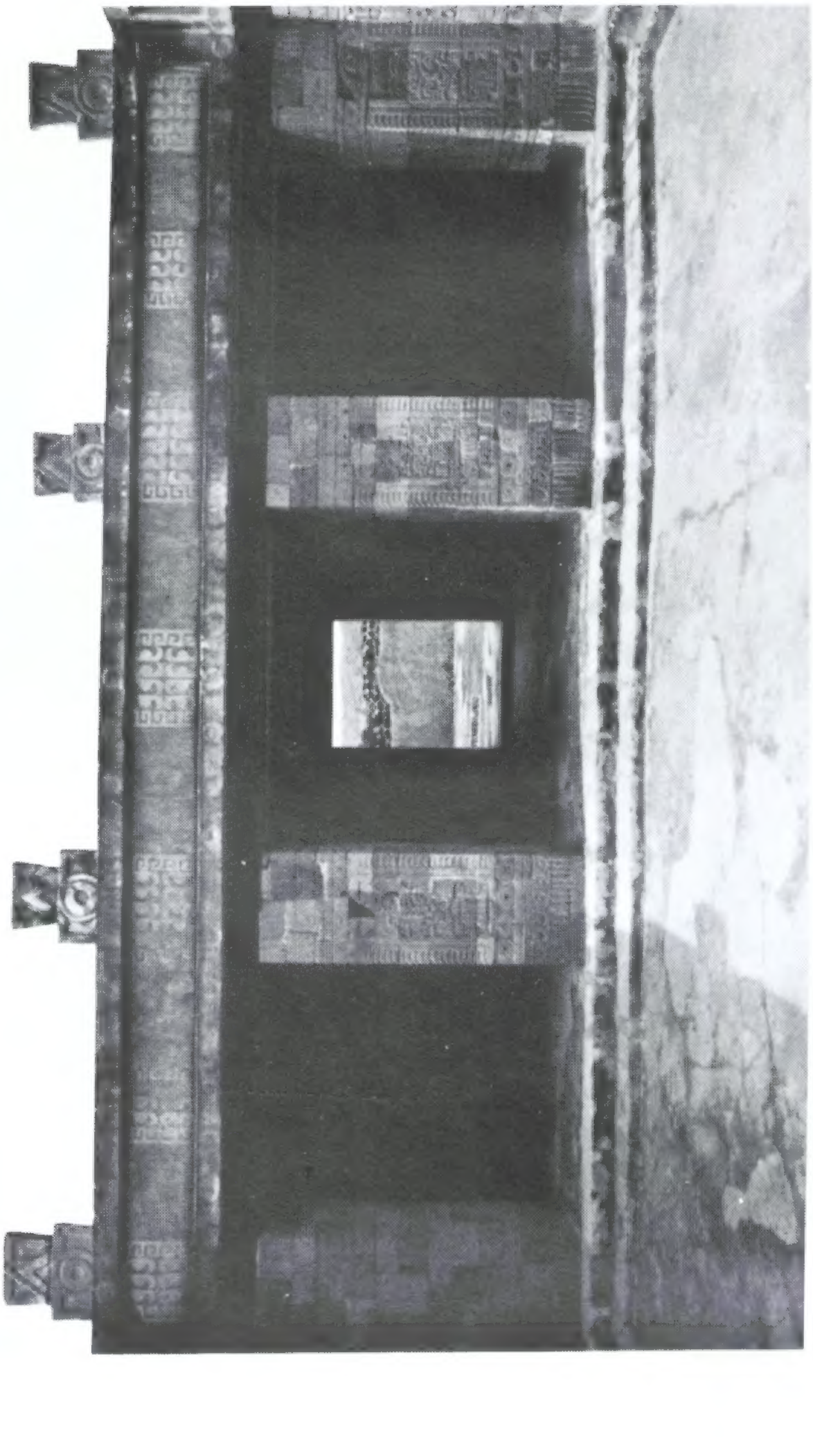

Plate 50. West side of courtyard, showing columns surmounted by painted lintel and carved stone 'combs'.

PLATE 51

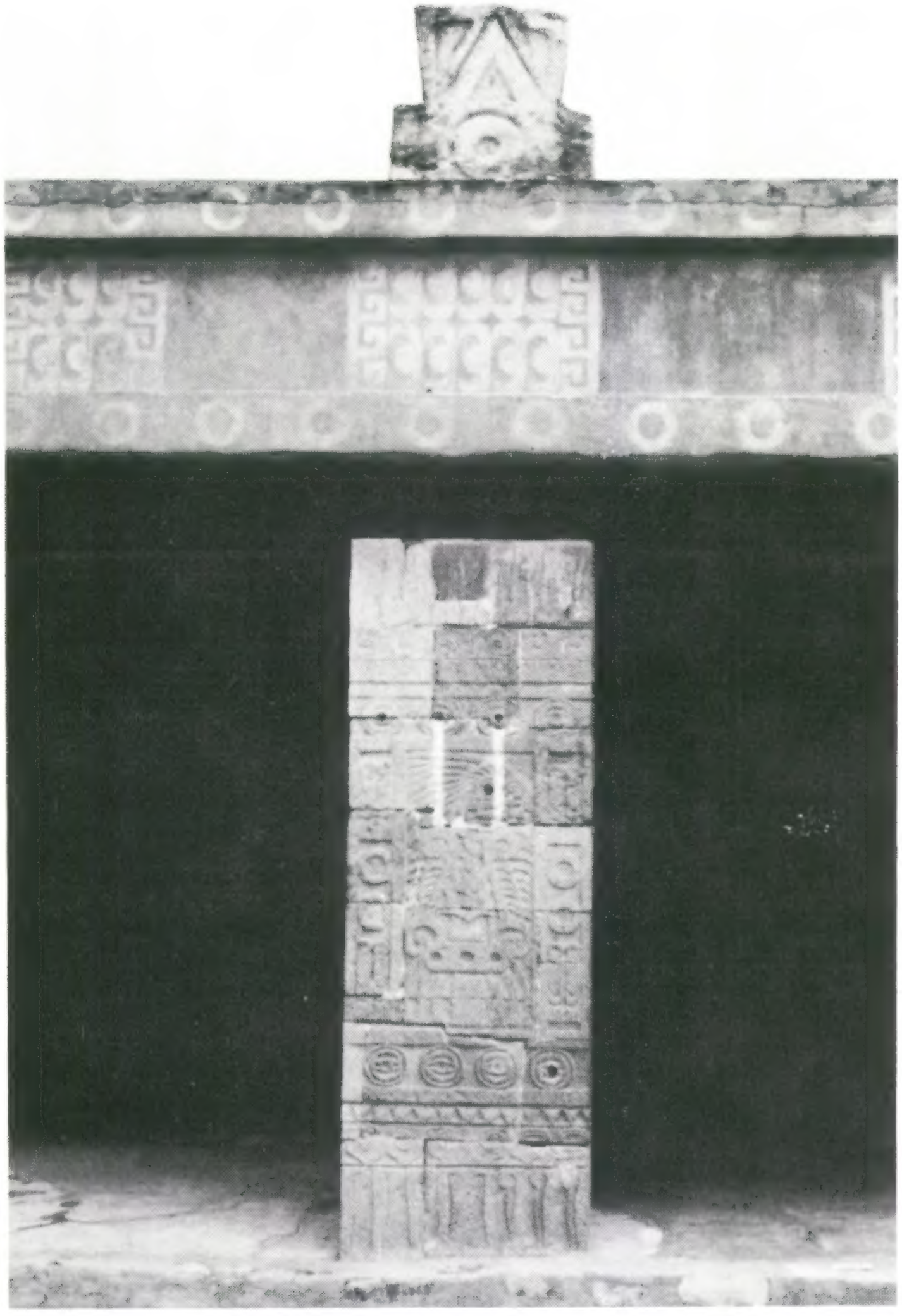

Plate 51. Column, lintel and 'comb'.